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WEST EUROPE REPORT SCIENCE AND TECHNOLOGY

No. 43

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CHEMICALS

EXPERT PROPOSES EXPORT OF ALCOHOL PLANTS, IMPORT OF ETHANOL

Munich SUEDEDEUTSCHE ZEITUNG in German 19 Nov 80 p 27

[Text] Biomass-derived fuel may be an interesting contribution towards solving the FRG's energy problem also. However, the necessary alcohol, ethanol, must be produced in countries where the plant raw material is continuously available throughout the year in order to permit uninterrupted production and to utilize the factories on more than a merely seasonal basis. Friedrich Jochum, chairman of the board of Maschinenfabrik Buckau R. Wolf AG, Grevenbroich, a company belonging to the Krupp combine, explains the chances and possibilities for producing alcohol from biomass.

Through the subsidiary companies, Buckau Wolf has been engaged for years in constructing factories for the utilization of plant materials. The 100-percent owned subsidiary Hermann, of Cologne, has been involved since the end of the 19th century with factories for manufacturing alcohol, and since then these activities have been completely absorbed into Buckau. Supraton GmbH, which is 51 percent owned by Buckau Wolf, has moreover developed a new process for digesting starch which is currently undergoing pilot-plant testing at the Institute for Fermentation Studies and Biotechnology in Berlin.

Known Technology

According to Jochum, the results are positive. The production of ethanol from re-growing plant raw materials such as sugar cane or manioc will assuredly permit, in the near future, an accessible means for getting out of an energy impasse, using known technology, which is therefore immediately available. If the energy for producing alcohol accrues as a by-product--combustion of residues and waste is possible with both sugar cane and manioc--alcohol production in tropical countries today is immediately economically feasible. Jochum views this as being a means of granting aid for development which would simultaneously give a boost to German engineering, create jobs in the developing nations and have positive feedback effects on the German economy.

According to Jochum, developing nations could pay for ethanol-producing factories by shipping alcohol to the industrialized countries. In the Ivory Coast, for example, he showed that an investment of DM 2.5 billion in 22 alcohol plants could

permit an annual ethanol production of 1.3 million tons, corresponding to about 5.2 percent of the German gasoline consumption. With an investment of DM 7.5 billion for 67 plants, one could get 4 million tons of ethanol per year, or 19.6 percent of the German gasoline consumption.

Moderate Manufacturing Costs

The manufacturing costs for this would run between DM 0.60 and 0.73 per liter, and at the same time 100,000-300,000 jobs would be created, especially in agriculture (planting and harvesting the sugar cane and manioc). After building a cane sugar plant in the Ivory Coast, Buckau Wolf found that the finished product could scarcely be absorbed by the sugar market. Things would be different with ethanol, according to Jochum.

Brazil and Japan are currently negotiating an alcohol project valued at 3 billion dollars for the Amazon basin. Brazil has already gone into manufacturing alcohol in a big way and plans to export alcohol to Western industrialized nations. The transportation costs from the Ivory Coast would be considerably less, at least for the FRG. If one compares ethanol production with a plan for coal liquefaction, then ethanol production is thoroughly competitive, explained Jochum.

8838

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ENERGY

PUBLICATION OUTLINES ENERGY POLICIES OF EEC NATIONS

Paris SEMAINE DE L'ENERGIE in French 27 Oct 80 pp 13-14

[Article: "Energy: the European Solutions"]

[Text] In a pamphlet entitled "Europe in Brief - Energy, the European Solutions," the Commission of the European Communities reviewed the energy policy of the nine countries of the EEC, before specifying the objectives and actions of the common energy policy being undertaken and before concluding with an essential imperative: energy savings.

1) The Energy Policies by Country (an outline)

- Belgium: . Stabilization of coal production
 . Further development of nuclear energy and of gas installations
- Denmark: . Doubling of coal between now and 1990
 . Implementation of the heat plan
 . Increased petroleum production
 . Probable referendum on nuclear energy in 1981
- Ireland: . Recourse to coal and peat
 . Exploitation of the few hydrocarbon reserves
 . Playing the wind energy card
- Italy: . Reduction of consumption
 . Increased recourse to coal
 . Important (but hesitant) nuclear program
- Luxemburg: . Reduction of industrial (steel industry) and private consumption
- Netherlands: . Increased recourse to coal and gassification
 . Reduction of gas production
 . Move toward a debate on nuclear energy
- Federal Republic of Germany:
 . further development of coal
 . Energy savings
 . But opposition to nuclear energy

- United Kingdom:.. Increased petroleum production (75 percent of the country's energy needs)
 - . Increased gas production (15 percent)
 - . Increased coal production
 - . Doubling of nuclear capacity (1990)
- France:
 - . The energy program of France is better known by our readers. We refer the interested reader to the document, published this year by DOCUMENTATION FRANCAISE, "Energy: French Life."

2) The Energy Policy of the Communities

- 25 billion francs in investments, financed by the EIB, for energy savings, the development of national resources, the diversification of imports.
- Petroleum: avoid being cut off through judicious stockpiling, a 10 percent primary energy reduction if necessary, the search for new deposits, the diversification of supplies.
- Natural gas: the turning point of 1985.
Raise the share of gas to 18 percent of energy consumption, develop retrievable reserves in the North Sea, improve the network of gas pipelines, continue drilling operations.
- Coal: yes, but. Conversion of thermal stations to coal, stimulate the use of coal in industry, develop new processes for production, transportation and transformation.
- Nuclear energy: a priority, security. The EEC has limited authority in the nuclear energy field. But nuclear progress is real there.
- Alternative sources of energy. Assistance is provided for the exploitation of solar and geothermal energy.
- Research occupies a choice position in the EEC. Nuclear energy has somewhat faded away to the benefit of thermonuclear pressure, the production of H₂, geothermal energy and energy savings.

3) Energy Savings

To save energy is to underwrite an insurance policy for the future. This thought served as the vital lead for the Commission, which anticipated:

- 20 to 35 percent savings in transportation
- 15 to 35 percent in industry and agriculture
- 50 percent in the household and tertiary sectors.

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ENERGY

TWO YEARS' ACTIVITY FOR GEOTHERMAL PROSPECTING COMPANY

Paris ENERGIE in French 28 Oct 80 p 16

[Text] The Geochaleur company is undertaking at la Courneuve (Seine-St Denis department) its third geothermal prospecting project. About 20 other operations should be conducted soon, Mr Robert Lion, chairman of Geochaleur, told the press last Wednesday.

Mr Lion, who is also delegate general of the HLM [Low-Cost Housing Program] National Union, said that the firm has 2 years of activity scheduled. In all, he reported, its drillings will be able to supply over 60,000 housing unit equivalents, which means a savings of 80,000 tons of petroleum equivalent a year.

The program that has just begun at la Courneuve will affect 2,891 housing units of the HLM Public Office of the city, as well as various municipal facilities, amounting to 3,500 housing unit equivalents in all. The HLM Office is in charge of this program, requiring a total investment of 25.8 million francs. It is being financed 80 percent by a loan from the Geothermal Board and 20 percent by the public regional facility.

The drilling itself should take about 3 months. The geothermal equipment will become operational in 1981 and should meet 42.5 percent of the heating and hot water needs, amounting to savings of 1,969 TEP [Tons of Petroleum Equivalent] a year in the first phase, and then 2,500 TEP a year after the scheduled expansion to a second drilling in 1981 on the same site.

Two other operations have already been begun by Geochaleur since it was established: one for a 2,200 housing unit equivalent complex at Coulommiers, and the other at Montgeron, for 2,500 housing unit equivalents. The energy savings expected will be 3,500 TEP and 2,350 TEP a year, respectively.

The Gecchaleur-National Company for the Application of Geothermal Energy firm was established in 1978 by the HLM National Union, the BRGM [Bureau of Geological and Mining Exploration], Charbonnages de France, the Caisse des Depots, and Credit Foncier de France.

Its goal is to provide builders of low and moderate-cost developments and local communities with technical and financial assistance. "For in the end," said Mr Lion, "they are the only ones who can feasibly implement such projects."

Geochaleur has a dual goal: to reduce energy imports, saving up to 1.3 TEP per housing unit per year, and to decrease the cost of heating for the consumers, by about 10 percent the first 3 years, and then 30 percent starting with the 4th year.

7679

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ENERGY

GASIFIED RESIDUAL OIL TO BE BURNED IN POWER PLANT

Stockholm NY TEKNIK in Swedish 25 Sep 80 p 7

[Article by Norbert Andersson: "Gasified Residual Oil Burned in Power Plant"]

[Text] The world's first power plant to be fired with residual oil is planned for Lysekil. The sulphur-rich residual oil is gasified under high temperature. The gas drives a gas turbine, while the surplus heat drives a steam turbine. The power plant could be completed in 1985. The effect is calculated at 160 megawatts.

The plant is to be fired with residual oil, rich in sulphur, from oil refineries. Heretofore no use has been found for it in Sweden and it has been exported.

The oil is partially burned under high temperature and acid deficiency. The gas thus obtained is cleaned of sulphur and drives a gas turbine, which in turn drives a generator. Surplus heat from both the gasification process and the gas turbine drives a steam turbine coupled to a generator.

Less Pollution

Emissions of sulphur, nitrous oxides, and heavy metals are lower in this type of power plant than in those using conventional combustion.

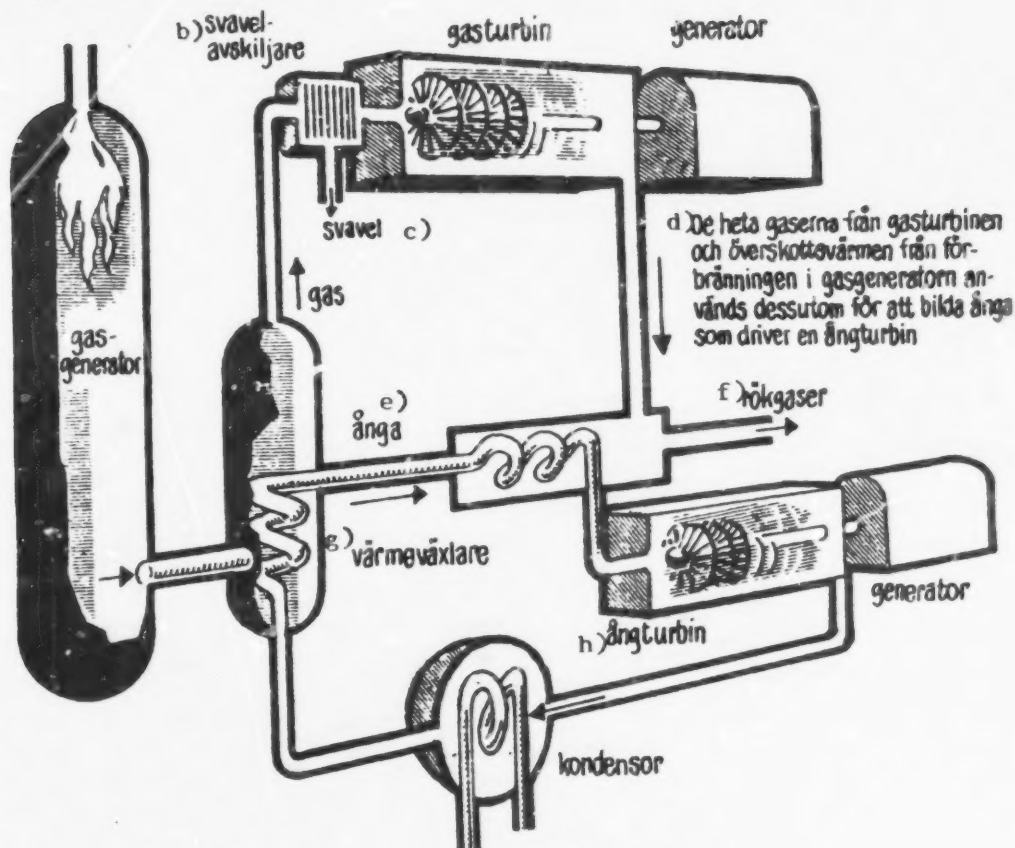
The parts of the system are based completely on conventional engineering. The new element is the combination of gasification with power production.

The demonstration plant of 160 megawatts now being planned is to be built in the Brofjorden industrial area in Lysekil. The project is being undertaken in cooperation among Swedish Petroleum, The Watercourses Administration, and SP Technology (formerly Statsraff.)

The planning work will be completed in 1981, and in 1985 the plant should be finished.

In the future this type of power plant may be operated with coal. "However, coal gasification technology is not yet mature and it is also costly," says Nils Elam, vice-president of SP Technology. He is convinced, however, that this type of combination power plant has a great future in Sweden.

a)
Återstodsolja, som fås som restprodukt
vid oljeraffinaderier, förbränns partiellt vid
högtemperatur i en gasgenerator



A combination power plant utilizes surplus heat from both the gas generator and the gas turbine for driving a steam turbine.

Key:

- a. Residual oil obtained from refineries is partially burned at high temperature in a gas generator.
- b. Sulphur separator
- c. Sulphur
- d. The hot gases from the gas turbine and surplus heat from combustion in the gas generator are also used to produce steam which drives a steam turbine.
- e. Steam
- f. Smoke gases
- g. Heat exchanger
- h. Steam turbine

11,256
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ENERGY

WIND TURBINE ACCIDENT ILLUSTRATED

Stockholm NY TEKNIK in Swedish 11 Sep 80 p 7

[Text] Sweden's first wind-driven power plant--the lime kiln at Alvkareleby--fell to the ground last week. The entire turbine enclosure fell from the top of the concrete tower, a drop of 23 meters. No strong wind or design error caused the fall of the power plant. The accident occurred when the turbine housing was to be lowered to the ground by means of a crane for overhaul and rotor exchange. The mobile crane was unable to handle the 7.5 ton turbine housing and it shifted and dropped. The accident injured no one, but material damage was great.

Most of the research program at the wind turbine plant is already completed, and it is not certain that it will be rebuilt.



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ENERGY

EXCHANGE OF EXPERIENCES WITH WIND POWER PLANTS

Frankfurt/Main ELEKTRIZITAETSWIRTSCHAFT in German 29 Sep 80 pp 772-773

[Text] A group of specialists of the Schleswig Aktiengesellschaft, the Hamburgische Electricitaets-Werke AG (HEW) and the Maschinenfabrik Augsburg-Nuernberg (MAN) gathered information on the situation of the plants on the Nibe-Fjord in Aalborg (Denmark) financed jointly by the Danish Government and the power industry.

Henning Gastrup, a civil engineer who has been in charge of the project since 1977, said: Unfortunately, we have not finished duplicating the old windmills." The starting difficulties have been much greater than expected since September 1979. Actually the basic assumptions had been agreed upon, but, as often happens, the "nuts and bolts" are giving trouble. Problems may have occurred in the plant controlled by microprocessors in different wind directions and velocities, also in the hydraulic systems (for example, the sheet angle shift).

In an exchange of views with the Growian Inspection Council chairman, Dr (of engineering) Clausnitzer (HEW), Inspection Council member and Schleswig Director Manfred Brohmeyer (Dipl. Ing.) and the heads of the Growian company Jens Niese (Schleswig) and Helmut Mitschel (HEW), the Danish engineers did not make any secret of the difficulties. Since September 1979, the first of the two wind power plants has only operated for about 149 hours. Result: About 28,000 kWh were fed into the neighboring 20 kV network.

In August 1980, the second "windmill" built with a different rotor suspension is to begin operating.

The first Nibe wind power plant on the green meadow is, with a tower height of 45 m, not even half as tall as the Growian planned in the Kaiser-Wilhelm-Koog at 96.6 m (Table 1).

The overall program pursued in Denmark since 1977 will cost about 32 million Danish crowns. About 19 million Danish crowns of this money must be allotted to the two Nibe windmills. The costs for Growian, most of which will be borne by the Federal German Research Ministry, are presumed to be approximately DM 50 million. In this connection it may be mentioned that the German research project is technically more complicated and more extensive.

		<u>Nibe</u>	<u>Growian</u>
Tower height	m	45	90.6
Rotor diameter	m	40	100.4
Power	kW	630	3000
Work (expected average annual yield)	GWh	1.5	12

Whereas the Nibe project, which has a favorable location from the point of view of wind conditions, reaches a total capacity of 630 kW for about 10 percent of the time (about 30 days), the German planners expect a full load (3,000 kW) for about 25 percent of the time (3 months).

9018
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ENERGY

EEC TO HELP FUND PHOTOVOLTAIC POWER PLANTS

Frankfurt/Main ELEKTRIZITAETSWIRTSCHAFT in German 13 Oct 80 p 817

[Text] The EEC is planning to build, in collaboration with individual state authorities, public bodies, industry and other establishments, on the basis of cost participation, more than a dozen power generators operating with photovoltaic cells, with a power of 30 to 300 kW in Europe. All the plants combined will have an electric power of about 1 MW. They will be completed by the middle of 1983.

This type of generator has not so far been built in Europe. In this project emphasis is laid on development of innovative techniques. Finally it should be proved with the plants, that the concept of generation of electricity from solar energy is economically feasible in Europe. At the same time, this program should give an encouraging stimulus to the solar energy electrification projects in developing countries, since it is creating the necessary technological principles. The solar power plants are to be selected from more than 30 proposals, which were received by the EG in May 1980. The proposals stem from many European consorti, who have thus responded to a call for bids published earlier within the framework of Solar Energy Research and Development Program of the GS (XII) Research, Science and Education.

The reactions on the part of the European industry were livelier than expected, and show that increasing interest is being aroused by the solar cell technique.

The commission proceeds from the principle that, as a rule, at least one plant will be built in each member country of the European Community, even those located in the north.

This is possible because the photocells work with high efficiency not only with direct solar irradiation, but also under cloudy skies and even during rain, assuming that some brightness is still present.

Solar power generators will be used predominantly on islands, in which the problems of power supply by ordinary means is not always easily solved.

"Solar electricity" can also be used to supply small municipalities, agricultural plants such as dairies, hospitals, schools and holiday resorts. A plant is to be built in Sicily in the immediate vicinity of Erellos, the 1 MW solar power plant of the European Community, which operates with a steam cycle, and is to be

commissioned by the end of 1980. This would provide the unique opportunity of comparing a plant working on the photovoltaic principle with a thermodynamic solar power plant.

All the projects are part of the program of the Commission for the Use of Solar Energy with Photovoltaic Cells, which also includes 35 study contracts on new solar cells and corresponding components on which the contracts are now being negotiated.

From 27 to 31 October 1980, the commission is organizing in the Palais des Festivals et des Congres in Cannes, a conference on photovoltaic technology, which is expected to be attended by 600 delegates from all over the world. The co-organizers of the conference are the Paris "Commissariat a l'Energie Solaire" [Paris Solar Energy Commission] and the IEEE, New York.

9018

CSO: 3102

ENERGY

BRIEFS

GEOTHERMAL DRILLING CONTINUES--In Coulommiers, in the Seine-et-Marne department, it will be possible to heat part of the city by geothermal energy starting in the winter of 1981-1982, since the second well drilled for reinjection by deflection has just been successfully completed. This operation, conducted for the Joint Geothermal Energy Board in Coulommiers by the BRGM [Bureau of Geological and Mining Exploration], will be able to heat 2,200 housing unit equivalents (HLM [Low-Cost Housing Program] complex, hospital, school facilities), and it will save 3,400 TEP [Tons of Petroleum Equivalent] a year. Last July, the first well, at a depth of 2,000 meters, reached porous limestone at the Dogger level, containing water over 80 degrees in temperature with a sufficient flow (200 cubic meters per hour). The second well which has just been drilled will permit the geothermal field to be exploited by using a "doublet" system; the hot water extracted by the producing well, once it is cooled after extraction of its calories in the heat exchanger, will be sent back to the same level by the reinjection well. The Coulommiers operation may be considered the archetype of the geothermal heating developments that are being conducted in the Parisian basin. [Text] [Paris AFP SCIENCES in French 23 Oct 80 p 30] 7679

PHOTOVOLTAIC CELLS--Elf-Energies, a newly formed subsidiary of the New Elf-Aquitaine Company, is about to sign an agreement with the CGE [General Electric Company] on photovoltaic cells. This agreement is to set up a subsidiary in which the CGE would hold a majority of the stock, with Elf-Energies having large minority holdings. The CGE is the French industry that is probably most advanced in this field, and is the only one which is involved with the government's photovoltaic plan. Since 1978 the CGE has been associated with the Rhone-Poulenc group for research and development of silicon-based materials and flat products. In 1979 it set up two joint subsidiaries with the Sensor Technology firm (Dyneer group), the third U.S. manufacturer of solar cells, and it is now turning toward the development of true solar systems. Elf-Energies has just entered the photovoltaic field, by its acquisition of minority holdings in the Bureau Yves Houssin and the Catel firms. Catel is an Ivory Coast firm, and we should mention here that the CGE is also involved in the Ivory Coast, through its subsidiary, Photowatt Afrique, which will produce photovoltaic generators and modules in Abidjan starting next year. [Text] [Paris ENERGIE in French 28 Oct 80 p 17] 7679

THEMIS SOLAR POWER PLANT -- The cost of the Themis solar power plant under construction in Targassonne amounts to 128 million francs for a life span of 20 years. The nominal power of 2300 kilowatts should produce 3 gigawatt/hours net per year, with an average yearly energy yield of 16 percent. The plant includes 200 heliostats, constituting a surface of 10,740 square meters. Thermal stockpiling is achieved by a mixture of salts (sodium, potassium) melted at a temperature of 290 to 400 degrees Celsius; its capacity is equivalent to 5 hours of sunlight. [Text] [Paris SCOOP ENERGIE in French 15 Oct 80 p 8] 8463

FLUIDIZED-BED TEST PLANT--A coalburning power plant with a fluidized-bed chamber is planned in Malmo. The final decision has not yet been made, but the intention is to build a combustion chamber of 15 watt thermal effect. It will operate at 850° C and 1.6 MPa [expansion unknown]. Stal-Laval Turbine, Inc., and Asea-Atom are planning the installation, built only to test on a full scale the process for coal combustion developed by Stal-Laval. A single gas turbine of special construction for the test is to be made. Further, the heat taken out for steam production is measured in full scale works, of the kind Stal-Laval plans to build in the United States. (Described in NY TEKNIK, 1980:35). [Text] [Stockholm NY TEKNIK in Swedish 18 Sep 80 p 17] 11,256

CSO: 3102

SCIENCE POLICY

REPORT OUT ON GENERAL ORIENTATION OF FUTURE RESEARCH

Paris AFP SCIENCES in French 2 Oct 80 pp 1-2, 4

[Excerpts] I. Policy and Organization of Scientific Research

Ten-Year Program, France. Paris. "Le Livre Blanc sur la recherche" [The Research White Book]. On 3 September, Pierre Aigrain, secretary of state for research, forwarded to the president of the republic the White Book on Research. The subtitle of this voluminous document of more than 500 pages is "Building the Future" and expresses its purpose, that is to say, the place which research must occupy in the nation and, more precisely, what we can expect of scientific research during the 10 years to come.

The White Book on the one hand constitutes "a kind of fresco of scientific and technical knowledge indispensable to the culture of the "sincere man" of the 20th Century as it draws to a close; on the other hand it replaces the research effort made by France in a 10-year time frame which gives it a prospective outline. "Enlightening the voter," as the "decision maker," on the organization and orientations of research, it "prepares the way to the future"—as it says in the introduction.

The White Book, published by Documentation francaise in 10,000 copies was released to the public on 1 October in the afternoon after submission to the cabinet by Mr Aigrain.

According to its drafting committee—made up of high-ranking personalities in science with contributions from numerous researchers—the White Book "reflects the entire scientific community," its own reflection upon the sciences, technology, their development during the years to come, the place which they have in our society, and their contribution to progress."

A famous physicist by the name of Jacques Friedel, member of the Academy of Sciences and professor at the University of Paris-South, chaired the White Book Drafting Committee which included specialists from all disciplines. Scientific institutions, such as the Academy of Sciences, the National Committee of the National Scientific Research Center, the Scientific Council of the National Institute of Health and Medical Research, the conference of university presidents, etc., were involved in its preparation.

The White Book consists of two parts. The first one is a very detailed analysis covering vast sectors of research, including industrial research, but not military research. The eight chapters devoted to it outline the state of knowledge and indicate the most promising fields where we are liable to see either conceptual breakthroughs or a rapid development of practical application.

The second part illustrates relations between the economy, science, and society and is a reflection on France's scientific policy so that the potential of the 300,000 persons involved in research in France may be used in the best possible fashion; the total financial effort will exceed F 50 billion in 1981 for research and development.

Commenting on the White Book in talking to the press, Mr Pierre Aigrain said: "This book is a goldmine. Many people are going to benefit from it. We will be the first in the government, in the various ministries, to use it as a source of information and inspiration." He however took care to place things in proper perspective by stressing that the White Book "is neither a blueprint for the government, nor a promise of specific results to be obtained by a specific date."

Indeed, although this document contains suggestions as to the creation of one or the other laboratory or the implementation of a research program here and there, the White Book overall does not spell out any specific objectives but rather comes up with general guidelines (AFP-Sciences will present an analysis of these guidelines in its next issue).

The White Book is coming out now because on that same day the president of the republic, in the cabinet, asked the government "to add a seventh priority to the six which had been listed during the debate on the preparation of the Eighth Plan, that is to say, to raise French scientific research to the level of the most advanced countries." "Scientific and technological research," Mr Pierre Aigrain indicated, on this subject, "will not only involve a priority effort but will be one of the major options and even the first option under the plan."

For Professor Jacques Friedel, member of the Academy of Sciences, who was the chairman of the White Book Drafting Committee--whose members on 1 October were received for a luncheon at Elysee [Palace]--"The task of reflection and drafting was not easy and the final product is not perfect." "The White Book was written by real researchers and that explains its length and its sometimes dull character but it is solid and substantial and it represents the general agreement of the scientific community." He added that "It was difficult to foresee the future and this is why the document in question rather outlines probably evolution of science and technology and what that might mean from the viewpoint of practical application and effects on the life of the French."

Major Scientific Activities Scheduled for the 1980/1990 Decade

I. Basic Research

1. LEP (Large Electron Positron) project at ECNR;
2. French participation in scientific program of European Space Agency;
3. Completion of Ganil (national heavy ion accelerator) at Caen (1982);

4. Synchrotron radiation machine (European Synchrotron Radiation Facility);
5. Completion of telescopes with millimetric interferometer (in collaboration with West Germany) (1986);
6. French participation in SPACELAB program;
7. VENERA probe for Venus;
8. Improvement of SATURNE, synchrotron accelerator with proton;
9. Second run of high-flux reactor of Laue Langevin Institute (French-Anglo-German).

II. Completed research

1. Completion of THEMIS solar power plant (1984);
2. Remodeling of Charcot oceanographic vessel (1981);
3. Construction of two new oceanographic vessels (starting in 1985);
4. Completion of Rennes pig-breeding station [as published; "porcine"; piscine(?)—pool];
5. Civilian participation in PHEBUS (high-power laser);
6. Completion of JET (Joint European Torus), within the framework of Euratom (1983);
7. New Tokamak TORESUPRA.

5058

CSO: 3102

SCIENCE POLICY

ASSESSMENT OF SWEDEN'S WORLD STANDING IN R&D EXPENDITURES

Stockholm NY TEKNIK in Swedish 30 Oct 80 pp 8-9

[Article by Rolf Myhrman]

[Text] Sweden is continuing to increase its research effort. This is shown by the latest OECD report, which has just been published.

The increase is occurring even though government appropriations are declining.

The reason is that Swedish firms are engaging in increasingly intensive research and reaching first place in world statistics.

The new OECD statistics show the development of R&D among the member countries up to and including 1977.

The OECD countries investing the most money in R&D are the following, in descending order: the United States, Japan, the FRG, France, and Great Britain. In 1977 those countries invested a total of more than \$82 billion (345 billion kronor) in R&D. That amount is approximately equal to Sweden's entire gross national product (GNP) for that same year.

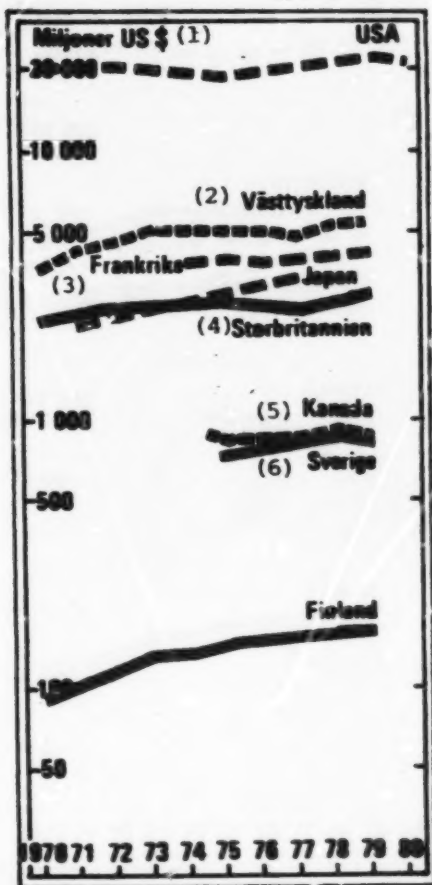
Ninth Place

Sweden ranks ninth in total R&D effort.

Sweden spent about 6.3 billion kronor on R&D in 1977. (But the statistics for Sweden do not include R&D in the social sciences and humanities, in contrast to all the other countries included in the statistics.)

If research funds are viewed in relation to the GNP, the figure for Sweden is estimated at 1.9 percent for 1977.

In the OECD, that figure is exceeded by the United States (2.4 percent), Switzerland (2.3 percent), the FRG (2.1 percent), Great Britain (2.1 percent), and the Netherlands (2.0 percent). (See the second diagram below.) Japan is at the same level as Sweden, while France shows 1.8 percent. The other countries are all below 1.5 percent.



Government-financed research in some OECD countries from 1970 through 1980 is shown here. The amount is shown in U.S. dollars at 1975 prices. Note that the scale is logarithmic. The figures for 1979 and 1980 are based on budgeted costs in the various countries. The diagram shows that government R&D appropriations in Sweden are beginning to decline if calculated at constant prices.

Key:

1. Millions of U.S. dollars
2. West Germany
3. France
4. Great Britain
5. Canada
6. Sweden

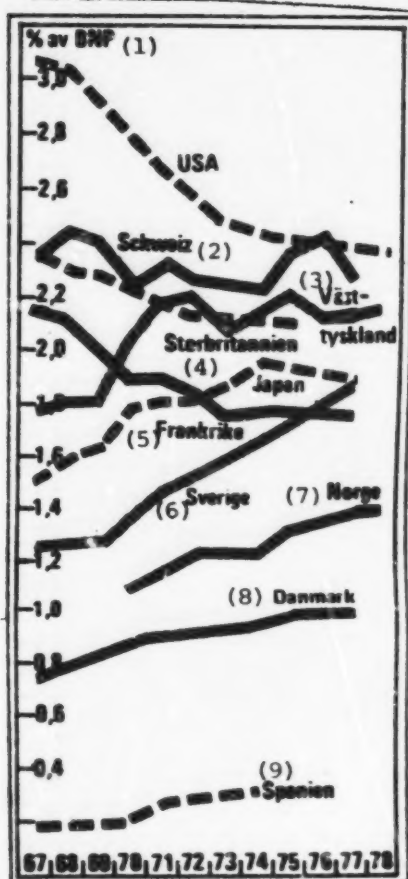
Norway, for example, devotes 1.4 percent of its GNP to research and development. The figure for Finland and Denmark is about 1 percent.

If we look at the figures for the private sector only, Sweden looks even better. The private sector includes both state-owned and private firms as well as research institutes that serve those firms.

More than half the research in all of the OECD's major R&D countries is assigned to the private sector. Sweden is one of the countries where the greatest share of R&D--nearly three-fourths--is done in that sector.

In NY TEKNIK No 38, we described the Swedish firms as being the leaders in R&D in the OECD group. This is confirmed by the new statistics.

If we look at the private sector's R&D effort in terms of what the firms contribute to the GNP, we see that Sweden is in first place. (This can also be stated as the private sector's R&D costs as a percentage of added value plus import duties.)



Total R&D expenditure as a percentage of gross national product for some OECD countries. The diagram shows the change from 1967 to 1977, expressed in constant prices. It includes all R&D within the particular country. If only the industrial sector's research is considered, Sweden is a little higher. One explanation for such a sharp increase in Sweden's R&D effort in the latter years of the period is that its GNP fell somewhat. With a rising R&D effort and a falling GNP, R&D's share of the GNP easily shows a solid increase.

Key:

1. Percentage of GNP
2. Switzerland
3. West Germany
4. Great Britain
5. France
6. Sweden
7. Norway
8. Denmark
9. Spain

Here Sweden achieves a figure of 2.0 percent, followed by the United States (1.9 percent), the FRG (1.6 percent), and France (1.4 percent).

In Sweden's case, that percentage has risen sharply in recent years. But at the same time, it must be remembered that industry--and its share of the GNP--declined during the same period.

There is another measurement for describing the intensity of research by private firms in the OECD countries.

That is the number of research workers in the private sector in terms of the total labor force (the number of persons of working age).

Here Sweden is in third place with a figure of 5.8 per 1,000. Switzerland and the FRG are ahead of Sweden, while Japan and the Netherlands are behind it.

Appropriations Drop

Government appropriations for R&D have increased in the OECD group as a whole. The increase is estimated at a little more than 5 percent between 1977 and 1979 (at constant prices).

Here Sweden is one of the few countries differing from the group as a whole. Calculated at constant prices, the appropriations have declined since 1978 (see the diagram).

In recent years, Denmark and Norway have also reduced their government appropriations for R&D.

The areas of government-supported research that are increasing the most within the OECD group are energy research and research into hospitals and health care.

Approximately one-third of the government research within the OECD is for defense purposes. The United States, Great Britain, and France account for 90 percent of that type of R&D.

Besides those countries, only Sweden and Switzerland spend more than 15 percent of their government R&D money on defense research.

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West Europe Report

SCIENCE AND TECHNOLOGY

No. 67



FOREIGN BROADCAST INFORMATION SERVICE

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29 July 1981

WEST EUROPE REPORT
SCIENCE AND TECHNOLOGY

No. 67

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ELECTRONICS

BRITISH 'SUPER-CHIP' TO REDUCE COST OF ELECTRONIC SYSTEMS

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 23 Jun 81 p 5

[Article: "New Microchip Concept From Ferranti"]

[Text] Frankfurt, 22 June. British Ferranti Electronics has just announced an epoch-making innovation in the production of a new type of "super" chip which will drastically reduce the cost of many electronic systems. If Ferranti is successful with this chip, it will repay many years of expensive development work, reported the FINANCIAL TIMES on 11 June.

The company, a member of the Ferranti group, has concentrated for 10 years on the production of a silicon chip holding a set of standard circuits which can serve as the cornerstone for any customer design. The unassigned logic array (ULA), or gate array, consists of a large number of microscopically small circuit elements such as transistors or diodes which are etched in a standard pattern. Customers can connect these circuit elements in whatever manner is required for the circuit design at hand. This is much cheaper than designing a special chip from the beginning.

In contrast to this, the large American and Japanese semiconductor manufacturers have concentrated on the mass production of standard chips which can be used as basic components of computer logic circuits and memories and for communication equipment. Specially designed chips or unassigned logic arrays are a natural choice where there is a requirement for highly complex circuits in a small package, as in camera controls for example. Such circuits have been neglected by the large American and Japanese semiconductor manufacturers who preferred to market large numbers of inexpensive standard chips.

Ferranti Electronics and its American subsidiary, Interdesign, in Sunnyvale, California, are thinking in terms of worldwide leadership with a 30-percent share of the market in unassigned logic arrays. People in the industry believe that these chips will be among the dominant technologies of the 1980's. The market volume is projected to be \$20 million toward the end of the decade.

Ferranti will distribute more than 20 types of unassigned logic arrays and has now also announced a new manufacturing process called FAB 2 which can package many more circuit elements on a chip.

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ELECTRONICS

BRIEFS

AGREEMENT ON BUBBLE MEMORIES--National Semiconductor and SAGEM S.A., Paris have signed a second-supplier agreement dealing with development, manufacturing and distribution of 256-kbit and 1-Mbit bubble memories (magnetic bubble memories). The production of the SAGEM version, which is compatible with National's NBM 2256, will begin in mid-1981. SAGEM has been involved with bubble-memory development since 1976. The company's production program includes data systems, navigation systems, special equipment--for the Airbus, for example--and numerical controls. National Semiconductor is the producer of integrated circuits, including microprocessors, as well as linear, digital and interface circuits. Their production program also includes IBM-compatible computer systems. [Text] [Munich REGELUNGSTECHNISCHE PRAXIS in German Apr 81 p 118] 9160

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ENERGY

FIRST FRENCH SOLAR POWER PLANT TO FUNCTION IN SEPTEMBER

Paris LE MATIN in French 20 Jun 81 p 18

[Article by Francois de Muizon: "The Solar Plant to Start Operation in September"]

[Text] THEMIS, the first French solar plant set up at Targassonne (Pyrennees-Orientales), will start operation in September. It is primarily a prototype, a tool intended to help research on thermal power plants and to study new components (transducers, heliostats, turbines). It is a "showcase" intended for developing countries which cannot afford or adapt to nuclear technology. Contested in its very principle, even by some ecologists who promote a "lighter" and more decentralized use of solar techniques, THEMIS was close to never being born: work was suddenly stopped in May 1979, as the result of a decision which had become symbolic, and was subsequently repealed under pressure from the public at large.

Targassonne is a small village in the Pyrennees-Orientales district of southwestern France, at 6000 feet altitude. On the slopes, in tight rows, are 200 53,7 m² solar reflectors arranged into a sort of amphitheater to pick up the sun's rays and make them converge on an "oven" located at the top of a 100-meter tower. A mixture of sodium and potassium nitrate and nitrate with a flow-rate of 3 kg per second is brought to a temperature of 450°C. These salts are placed in contact with water on their way down the tower. The steam thus produced is fed into a 2500 kW turbo-alternator which produces electricity. Such is the operating schematic of one of the three largest solar power plants in construction in the world, THEMIS, the child of the EDF (French Electrical Company) and the CNRS (National Center for Scientific Research), whose work is nearing completion as the operating date of September draws near.

At noon in June, in the best sun conditions, THEMIS picks up 11 MW of solar energy to produce 2.3 MW of electricity. Yearly production is expected to be 3 million kWh, or the equivalent of the electrical needs of a city of 2,500 people. THEMIS will cost 128 million francs, and depreciation is planned over a 20-year period, which brings the price of one kWh to 5 F (about \$1.00), or six times more than gas.

But THEMIS is an experimental prototype plant: it hosts the National Center for Solar Experimentation, and it cannot be compared commercially with other sources of energy. The price of heliostats (3,000 francs per m²) is heavy on THEMIS' budget. Moreover, the technique being used: light and complex mechanical

structures supporting panels made up of two sheets of glass, one of them 2 mm thick, separated by a silver-coating, is questioned by experts. Considerable expenses have been invested to automate the tracking of the sun by the panels which must project the sun's rays at more than 100 m to the oven.

Steam return to the atmosphere is not considered: a "dry air-coolant" is to be tried at Targassonne. It consists of an enormous radiator made up of quadrangle-shaped metallic structures 30 m high where steam will be condensed at the output from the turbo-alternator. If the experiment is successful, the EDF is considering using this equipment in nuclear reactors. On the other hand, the cost of the salt is negligible. A 535-ton load costing 10 million francs is required at the start. Its life is the same as that of the plant. Finally, THEMIS is dependent completely upon the sun. At Targassonne, experts count upon good sun availability, but wind may be detrimental to the plant's operation: at wind speeds over 50 kmh, the heliostats must be located face down or run the risk of being damaged. This is a handicap.

"For us, the THEMIS type direct solar convection method may not be the optimal solution and we are not certain today to be able to reduce the costs by a factor of 2 or 3, which would be the only way to give this technique a future," says Marcel Fagot, Director of the Equipment Agency for the Alpes-Marseilles region.

On the other hand, in certain regions of the world with good sun availability, and where transportation of energy is a large part of electricity costs, such as in Australia, THEMIS type solutions may be interesting, especially since cost reductions may be effected in several areas. For instance, new types of panels manufactured at a cost lower than in THEMIS have appeared on the market since the construction of the plant. A cheaper type of oven than the one used in the Targassonne plant is also available now. Finally, the automatic operation of the plant will be fine-tuned progressively, which will reduce costs.

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ENERGY

FRANCE CONSIDERS COAL CONVERSION FOR ENERGY DIVERSIFICATION

Paris L'USINE NOUVELLE in French 4 Jun 81 pp 75-77

[Text] While the speeches dealing with gasification in France are now innumerable, it is still quite difficult to know what our status is in this area. L'USINE NOUVELLE takes inventory of the opposing forces and deals with the stakes, plans or studies now in progress.

Ex situ gasification of coal in France, which raises economic, technical and political problems, constitutes the very type of tricky case which needs to be approached carefully. Its complexity is derived from the number of participants and the diversity of their motivations as well as the multiplicity of channels and processes and, of course, the size of the investments to be placed.

Nevertheless, while it is a certainty in this area, it is incontestable that France has fallen behind considerably (due to the decline in its coal production) with respect to countries such as the United States, Germany or Great Britain (all big producers of coal) which have devoted substantial resources to the development and improvement of gasification channels and processes, some of which are already in the industrial phase.

Therefore, when, after occurrence of the two petroleum industry shocks, France was faced with the question of employing coal as a means of diversification of energy sources, there remained (except for direct use of coal in boilers) only one solution for development of gasification, namely, acquiring the license for one of the processes which had been proven abroad, even if it had to be adapted to the conditions peculiar to the French market. Nevertheless, 3 years after this *petitio principii*, no process has yet been selected.

This dilatoriness is conceivably due to the extreme diversity of and the often divergent motivations of the interested parties. The leader of these is Gaz de France whose medium-term (perhaps long-term?) objective is still the production from imported coal of substitute natural gas (SNG), intended to be, due to its high heat-producing capacity (9 thermal units per cubic meter), injected into the distribution system. However, the short-term goal is to begin by producing gas with a medium heating capacity (3 thermal units per cubic meter), intended for factories located near the gasification plant (within a radius of 20 to 30 kilometers) or else to be diluted to 10 percent of its initial strength and then injected into the distribution system. In any case, the objective is to minimize possible problems of supply of natural gas and, above all, the inevitable increases in price.

Next in importance come the chemical firms, particularly CdF-Chimie, which is the biggest producer of ammonia and methanol in France. Its interest in gasification techniques becomes obvious when it is learned that these two basic chemical products, which are now manufactured from methane (10 percent of French consumption), could just as well be made from synthetic gas and that CdF also happens to produce coal in Lorraine (10.5 million metric tons per year).

The third group consists of petroleum companies which are interested in gasification for three reasons. Firstly, they want to treat residues of very heavy crude oils (coke). Then, in connection with the carburel program, they would like to manufacture methanol to be mixed with gasoline. Finally, simply for diversification in connection with a coal policy that would combine the source (purchase of mines) with the supply (direct or indirect use of coal).

In addition to Charbonnages de France, which believes that it has something to say on this matter and which is consulted on technical phases, we should also mention the engineering firms and big equipment manufacturers (Technip, Creusot-Loire, Heurtey, etc.) which parade all of their know-how and talents of persuasion for the purpose of capturing large markets. A plant that consumes 1000 metric tons of coal per day is worth 1 billion francs!

Finally, last but not least, public authorities, who are solicited by everyone in their role of providers of funds, have displayed a mitigated position in this area. Thus, they have never hidden the fact that direct use of coal (in boilers, for fuel oil-coal mixtures, fluidized beds) was considered by them to be better suited for industrial use while only certain aspects of gasification were considered for the manufacture of methanol fuel (with regard to carburel).

The second reason for hesitation is the diversity of techniques. Without going into detail (see the table below), it should be pointed out that of the dozen or so existing processes, only three have been marketed after having been subjected to industrial testing. These are the so-called first generation processes (Lurgi, Koppers, Winkler) which were developed in Germany before and during the war. Using the reaction of a mixture of oxygen and water vapor with coal, they produce a gas of industrial quality. Their efficiency is low (50 to 65 percent). Other processes--of the second generation--(Texaco, Shell Koppers, Saarbert Otto) have nearly completed their development phase. Operating at high temperatures, they eliminate tars and phenols and have an efficiency of 75 percent. Finally, there exists a whole string of processes for use in the future, including the Lurgi ash fusion process developed by the British Gas Council, the U-Gas process of the Institute of Technology of Chicago and a second generation Winkler process.

Following are the French projects:

The project tabled by Gaz de France: At first, GdF awarded study contracts to various engineering firms for the construction of a gasification unit with a capacity of 1000 metric tons per day to be placed in service around 1984 or 1985 and intended to produce 300 million cubic meters of industrial gas per year. Thus, Creusot-Loire was merged with Texaco, Technip with Winkler, Loire Entreprise with Lurgi, etc., although, in certain cases, these were only mergers of convenience (see box). As for the Shell Koppers project, it was not retained since it would not be for sale for 5 years. The projects are to be resubmitted

within 2 months and the decision is to be made by the end of the summer. Although the site has not yet been chosen officially, it is already reasonable to assume that it will be Le Havre. Texaco is the initial favorite but Lurgi has many industrial recommendations. The financial factor will be the determining one. In the second phase, GdF plans the construction of a unit ten times the size for the manufacture of SNG. "At the present time," confessed Pottier, in charge of the mission in the research administration of Gaz de France, "we have encountered methanization problems since the catalysts cannot withstand impurities in the gas." This is why GdF, in conjunction with IFP at Alfortville, is studying means of solving these problems. Nevertheless, the fact remains that the final figure for efficiency does not exceed 45 percent and that the price of SNG obtained by means of this process is far from being competitive with that of natural gas.

The two studies conducted by CdF-Chimie: A feasibility study is being carried on for the construction of a plant (capacity of 1000 metric tons per day) for the manufacture of ammonia at Mazingarbe, intended to replace a former plant operating half on natural gas and half on coking plant gas. Several processes are being considered but Marcel Bohy, in charge of the mission in the research administration of CdF-Chimie, does not hide the fact that he favors Lurgi, saying "Lurgi is the only plan that has been fully developed."

Furthermore, at the request of public officials, a study is being conducted for a plant (2500 metric tons of coal) to manufacture methanol (1500 metric tons per day) at Carling. According to CdF-Chimie, it appears that "the Texaco process has the inside track," but it is also conceivable that the two Lurgi and Texaco reactors will be coupled, thus making it possible to employ both coal pieces and fines.

Ideas furnished by oilmen: A research and development program is now being studied with regard to the Texaco process (Creusot-Loire is in charge) bringing together CRF, Elf, GdF and IFP. Nevertheless, no decision will be made before September with regard to this pilot plant which has a capacity of 50 metric tons per day. The board of directors was consulted but has not yet rendered its decision. However, selection of the site has proved to be a delicate matter since Elf prefers Solaize and CFR has opted for Le Havre.

No Lack of Ideas

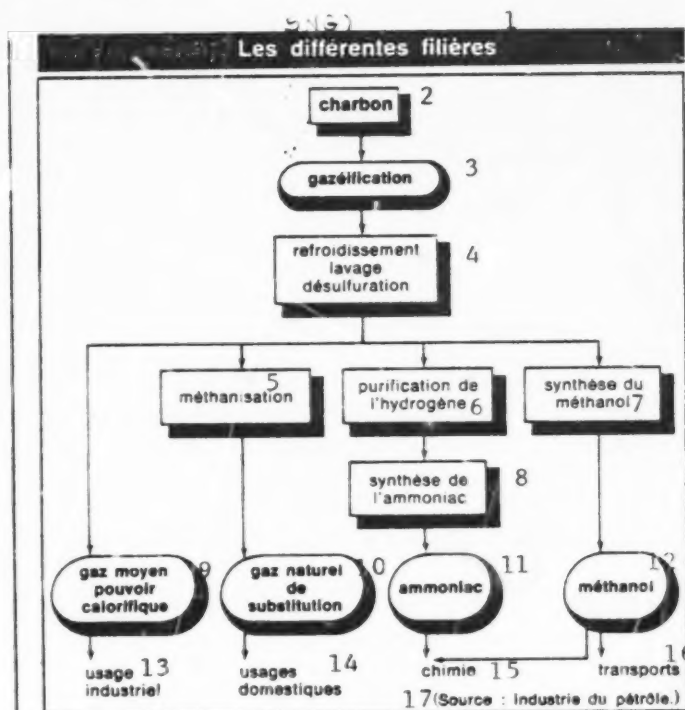
Furthermore, both companies are working on their own projects (perhaps at Le Havre and Donges), although these are being kept "top secret." Nevertheless, it is known that Technip is conducting two studies on methanol for the oil companies. It can be seen that there is no dearth of ideas even though feasibility studies outnumber firm projects. If there is a delay in construction, this is due to the fact that the problem of competitiveness with respect to traditional sources of energy still remains. According to Jean Pottier of GdF "A gasification plant that would begin operations today would not be profitable. The ratio between gas obtained and heavy fuel is 1.5." Furthermore, the magnitude of investment required is a deterrent factor. This is why the future of coal gasification in France will depend on the attitude of the new government.

Box: The Texaco Case

The American Texaco process is intriguing to the French but its principal drawback is that it only exists in the pilot plant form in the United States. Since it is derived from petroleum techniques, it is favored by the oil companies. As for Creusot-Loire, it has installed itself as the herald of the process by proposing to adapt it to French conditions. However, this does not necessarily mean that it will enjoy a monopoly with regard to this process.

Thus, Technip, merged by GdF with Winkler to meet the requirements of studies preliminary to construction of the first gasification plant, is working on other processes in addition to the Texaco process. "At the present time we have two people working with Texaco in the United States and we have already seen several study contracts awarded to France for the manufacture of methanol by this process" says Adrien Azoulay, Director of the Chemistry Department at Technip. Although it is attractive from many points of view (guarantee of coal injection, low pollution level, high efficiency, flexibility of use), the Texaco process poses several high temperature problems (resistance of refractories, cooling jackets, recovery of output heat) as in the case of coal. However, insists Creusot-Loire "Since the Shell Koppers process is not for sale and since Saarberg and Lurgi are only assemblers, it is the only one (Texaco does not prescribe any particular builder) to work on a process which is not perfect."

1. The various channels.
2. Coal.
3. Gasification.
4. Cooling, washing, desulfurization.
5. Methanization.
6. Purification of hydrogen.
7. Synthesis of methanol.
8. Synthesis of ammonia.
9. Medium heat output gas.
10. Substitute natural gas.
11. Ammonia.
12. Methanol.
13. Industrial use.
14. Domestic uses.
15. Chemistry.
16. Transportation.
17. Source: Industrie du Pétrole.
18. The gasification subprocesses are promising. From conversion of industrial gas to methanol, including SNG and ammonia, it constitutes a significant means of energy diversification.



Les voies de la gazéification sont prometteuses. De la production de gaz industriel au méthanol, en passant par le GNS et l'ammoniac, elle constitue un moyen de diversification énergétique non négligeable.

Lurgi, Koppers and Winkler, all three of them German processes, are the only ones to have been developed industrially. The others exist only in the form of pilot plants.

Les principaux procédés de gazéification					
	2	3	4	5	
	Stade de développement	Charbon utilisé	Réacteur	Température	Pression
Procédés de première génération 6					
Lurgi	7 Industriel (RFA)	8 Non agglomérant 11	9 Lit fixe 12	10 Basse (540 °C) 13	30 bars 14
Koppers Totzek	Industriel (RFA)	Tous types 11	Lit entraîné 12	Haute (1 500 °C) 13	Atmosphérique 14
Winkler	Industriel (RFA)	Plutôt lignites 15	Lit fluidisé 16	Basse (750 °C)	Atmosphérique
Procédés de deuxième génération (avancés) 17					
Shell Koppers	18 Pilotes (RFA)	Tous types	Lit entraîné	Haute (1 500 °C)	50 bars
Texaco	Pilotes (USA) 19	Tous types	Lit entraîné	Haute (1 500 °C)	30-80 bars
Saarberg Otto	Pilote (RFA) 19		Bain de laitier 20	Haute (1 650 °C)	30 bars
Procédés pour demain 21					
U-Gas (IGT)	Pilote (USA)	Tous types	Lit fluidisé	Haute (1 000 °C)	6-20 bars
Hygas (IGT)	Pilote (USA)		Lit fluidisé	Haute	80 bars
Lurgi à fusion de cendres (BGC)	Pilote (G-B) 22	Tous types	Lit mobile 23	Haute (1 500 °C)	30 bars
Winkler	A l'étude 24			Haute	

Lurgi, Koppers et Winkler, tous trois procédés allemands, sont les seuls à être développés industriellement. Les autres n'existent qu'au stade de pilotes.

Sources : Roger Dumon (« Le Renouveau du charbon », Masson) et « L'Usine Nouvelle », 25

1. The principal gasification processes.
2. Stage of development.
3. Type of coal used.
4. Type of reactor.
5. Pressure.
6. First generation processes.
7. Industrial plants (West Germany).
8. Non-binding.
9. Fixed bed.
10. Low.
11. All types.
12. Driven bed.
13. High.
14. Atmospheric.
15. Generally lignite.
16. Fluidized bed.
17. Second generation (advanced) processes.
18. Pilot plants (West Germany).
19. Pilot plant (West Germany).
20. Slag bath.
21. Future processes.
22. Lurgi ash fusion process.
23. Mobile bed.
24. Under study.
25. Sources: Roger Dumon ("Le Renouveau du Charbon," Masson) and "L'Usine Nouvelle."

7619

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ENERGY

COMPANIES IN RACE TO MARKET COAL-WATER FUEL FIRST

Stockholm SVENSKA DAGBLADET in Swedish 28 Jun 81 p 26

[Article by Bosse Pettersson]

[Text] Let us have liquid carbon warm up Sweden! This is going to be the slogan when Nynas and Boliden are in a race to market a new fuel.

The large companies have invested tens of millions in the development of a functional purified coal-water mixture. The important point is that it can be used in the existing oil burners and will not require purification of the exhaust air. The oil distribution network can also be used for the transporting of this fuel.

Two companies are in a race to be the first one to market the fuel. One of these, Carbogel, is owned by Boliden and the inventor company Scaniainventor in Helsingborg. Nynas Petroleum, Granges Hedlund and Cementa are behind the other company, Nycol.

The companies do not question that there is going to be a breakthrough. It may take 6 months to 2 years before it will be sold commercially.

Managing Director of Nycol States: "We Are Partners"

Neither Carbogel nor Nycol want to acknowledge that there would be a race between the two of them. Both parties also emphasize that they know very little about what the other one is doing. Despite the indifferent attitude Torsten Lundstrom, Boliden's project leader for Carbogel, admits: "It is very important to be first on the market."

Lars Rey, managing director of Nycol:

"I am not being a hypocrite when I say that I consider Carbogel rather as a partner than as a competitor. It is good for the customers to have several suppliers."

Carbogel was started already in 1973-74 and some time ago the project of developing a 70 percent coal and 30 percent water mixture was started. Combustion experiments are being performed at, among others, the Boliden lead foundry at Helsingborg. Nycol was not started until this fall. I is now relying on imported American technology in order to catch up. The production will start in the beginning of

August in the factory that Cementa recently shut down in Stora Vika off Nynashamn. Almost the entire cement production equipment can be used: mills, cisterns, etc. That makes it possible to quickly build out the production.

"It is possible that it will be Carbogel that sells the first tons," says Lars Rey. "But they will not be ahead of us on a large scale."

Landskrona Possible Location of Carbogel Factory

Lars Rey believes that Nycol will produce 700,000 tons in 1983. Torsten Lundstrom is more cautious. His prognosis is: "Some 100,000 tons in 1983-84." A production of that size requires investments in the 100 million range. A new factory is required for Carbogel. Its location may be Landskrona, in case there will be a coal harbor.

Neither one of the companies is afraid of expanding too much. Torsten Lundstrom believes in a future market of 10 million tons per year. One of the goals is the district heating plants. There are about 70 such plants that were built at about the same time and all of them are in the same economic situation. All of them would be eager to use a fuel that could be used in the oil burners after a minor reconstruction.

The industries are other possible buyers. It is, however, disputable that liquid fuel would be an alternative for the largest power plants.

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INDUSTRIAL TECHNOLOGY

FRAUNHOFER INSTITUTE STUDIES DESIGN OF ASSEMBLY ROBOTS

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 19 Jun 81
p 1

[One of a series of articles on industrial automation by Hellmut Droscha:
"Industrial Robots Learn, See and Feel"]

[Text] Frankfurt, 18 June--In the area of handling and assembly, it is frequently asked whether a special machine or a robot is more advantageous with regard to reprogramming. The Fraunhofer Institute for Production Engineering and Automation (IPA) (see also BLICK DURCH DIE WIRTSCHAFT of 16 June) has determined that in the case of a special machine only about 20 percent of its hardware is reuseable and 80 percent must be scrapped while in the case of robots it is approximately the reverse.

The IPA also investigated another completely different question: What all is involved from the standpoint of design to fashion an intermediate or an end product so that it is suitable for handling, or in a broader sense so that it is suitable for automation? It was shown that assembly is simplified when the motions required for joining parts--assembly motions, in the language of the trade--involve the smallest possible number of degrees of freedom, for example longitudinal motions, transverse motions and turning motions to the left or right. Snap joints in the sense of spring-loaded detente are very good. The parts or work pieces must be easy to load into and remove from magazines. It is very expedient to design parts so that they can be put together as subassemblies, for example automobile engine and steering system assemblies. New joining methods--bonding, for example--offer great advantages. The preceding recommendation by no means exhaust IPA's list.

In mass production, mechanical assembly starts with small parts usually vended as bulk goods from supply bins. The general trend is toward larger bins which have to be refilled less often, with productivity gains from mechanized separation of parts using vibrating conveyors. In the area of vibratory sorting devices, one manufacturer, Rhein-Nadel Automation, has developed a new compact device, a mobile sorting-bin floor which is not attached to the oscillating mass but is carried on a base plate. This device represents an improvement with respect to the smooth flow of parts, noise reduction and protection of parts. But quite apart from this, it is also an improvement for storing, ordering, transporting, sorting and positioning of parts for which the oscillatory conveyor is not well suited, often due to adverse operating conditions.

In this case, the parts are also dumped disordered into a deep bin. They are then moved up to machine level by two stepless-control-equipped tandem conveyors, the second of which climbs with respect to the first. At machine level an ordering and presenting unit, which can be adapted to parts of varying shape by adjusting or removing and replacing certain of its parts, completes the ordering and sorting of parts which was begun on the bin conveyor.

IPA has developed a small installation for ordering and magazining of small to medium quantities of binned parts. It is controlled by several synchronized microprocessors of various types. The conversion associated with changing from one type of workpiece to another is completed in less than an hour and requires for its initiation--if the shape of the part is not too complex--only the call up of a new program. No mechanical changes are required. The system has the following components: a parts bin; a flexible, program-controlled sorting unit; a video sensor for part recognition; a gripper for rotating the parts into the correct position; a program-controlled manipulator system with tactile sensors; program-controlled, positionable conveyor belts, a four-axis manipulator system for removal of cartoned parts and position controllers.

At the same location a freely programmable total assembly system is presently being set up. Using the simplest possible components, several assembly robots and conventional assembly stations will work together in such a manner that the system can be adapted to many varied tasks simply, rapidly and inexpensively.

A decisive step was taken with the further development of industrial robots from the blind-and-senseless first generation to the seeing-and-feeling second generation (Brown, Boveri and Cie, BBC) in which an optoelectronic measuring and sensing system (OMS) takes over, to a certain extent, functions of the natural eye. By means of a commercial video camera, it can recognize and measure objects in any angular position. By virtue of this feature the new system is suitable for optical inspection and for control of manipulating automats via a three-axis positioning device under microprocessor control. The entire system is then an optoelectronic positioning system (OPOS) with which--somewhat modestly expressed--new avenues are opened for the realization of flexible feeder systems. In material-flow systems, after the parts have been fed-in and separated, it can reorient them into the position required for gripping. Only recently has a standard interface between optical sensors and the automat's control section become available, and the limits of application are still difficult to project.

One such system which was developed jointly by IPA and a screw manufacturer is being used for automatic visual inspection of screws. Noncontact measurement is effected with a universal optical sensor used in conjunction with a commercial video camera. The screws are separated and continuously moved through the picture field with illumination from the back. Any screw with incorrect length, diameter of thread is thrown out. (To be continued).

9160
CSO: 3102/315

SCIENCE POLICY

BRIEFS

NORWEGIAN-FRG RESEARCH COOPERATION--(NORSK TELEGRAM BYRAA). Norway and West Germany will cooperate in nine research projects, which altogether will cost 95 million kroner. Of this amount, almost 59 million kroner will be used for research and development work in Norway. The funding will require 72 million kroner from Norwegian and West German public monies, and of that amount West Germany will cover 47 million kroner. The remainder of the costs will be handled from industry resources. The funding will mean a total transfer to Norway of about 20 million kroner in research funds. The cooperation is a result of two years of talks between the Ministry of Industry [of Norway] and the West German Ministry of Research and Technology. [Text] [Oslo AFTENPOSTEN in Norwegian 1 Jul 81 p 10]

CSO: 3102/327

TRANSPORTATION

BAE 146 TO KEEP UK IN WORLD CIVIL AIRCRAFT MARKET

Paris AVIATION MAGAZINE INTERNATIONAL in French 15-30 Jun 81 pp 32-33

[Article: "The BAe 146: A British Asset?"]

[Text] Photo caption: Without presenting any radical characteristics, the BAe 146 stands out due to the adoption of tried and tested technical solutions. This T-tail assembly, high-wing, four-jet aircraft may well fill a market which is very valuable but slow in emerging.

In Hatfield, on 20 May at noon, the first British Aerospace 146 left its assembly shop. The development of this 93-seat, four-jet, short-haul aircraft clearly demonstrates England's determination to maintain a full national production and marketing capability for civil aircraft, while also keeping a hand in cooperation, notably in Europe, through Airbus Industrie. But in order to pursue this twin policy, the national aircraft first has to be sold.

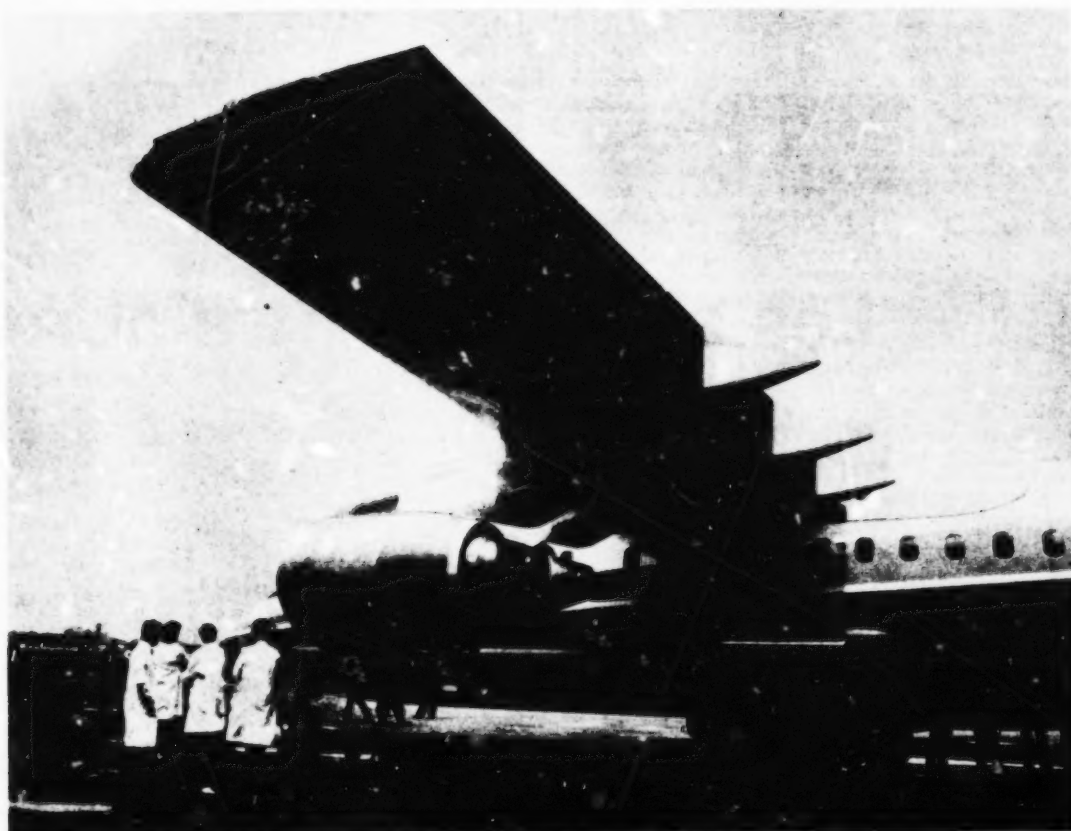
Once considered a passenger plane meant to bolster the British industry plan of attack, the HS-146, which has become the BAe 146, is now one of the assets on which Great Britain relies most heavily to keep its place in the civil aircraft market.

Marketing was off to a very slow start. At the time it left the plant, the BAe 146 had officially been selected by only one Argentine private company, LAPA (Lineas Aereas Privadas Argentinas), which in June 1980 had placed one firm order for three planes and taken an option on three more. This contract was estimated at 85 million dollars at the time.

On the eve of completion of the prototype, British Aerospace announced a new order, from Air Wisconsin, an American company, which signed a contract on 16 May for four planes and four options. The initial order is estimated at 70 million dollars. The first planes will be delivered to the American company in March 1983.

Another American group, Westair Holding Corporation, owner of two companies, Westair Commuter and Pacific Express Airlines, with which British Aerospace had been negotiating for several months, recently obtained agreement from its board of directors to place six planes on firm order and take an option on eight more.

In all, there are therefore 13 firm orders and 15 options for the BAe 146.

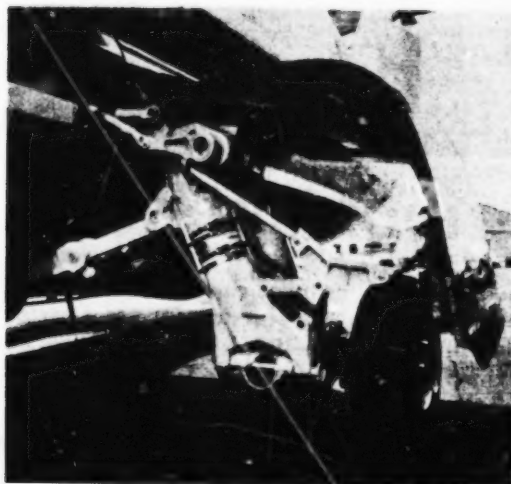


The BAe 146 is highly lift-augmented, but its flap supports are markedly set back and have bulky fairing, even though the two inboard elements provide continuity for the jet-bearing struts. Note trim tabs and static balance horn on wingtips.

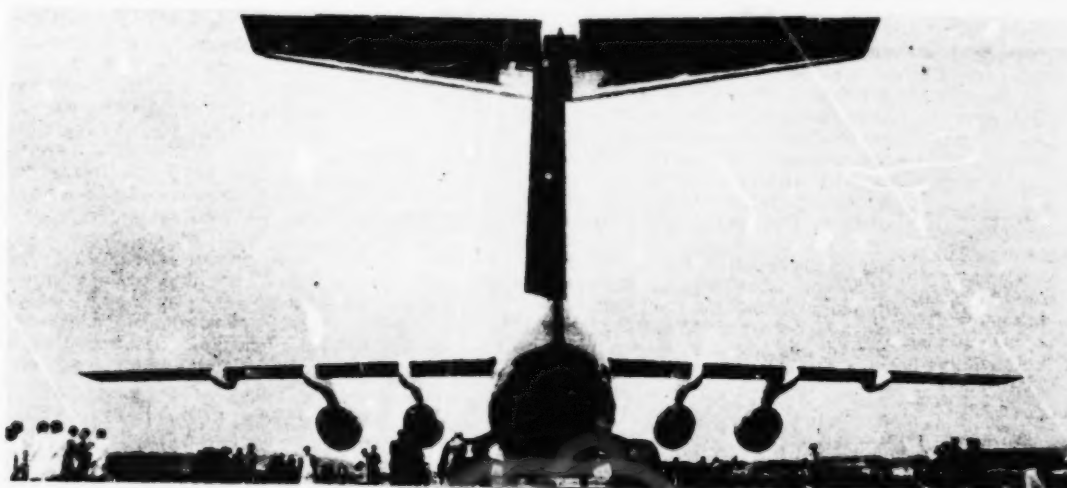
Three planes will be involved in the perfecting and certification procedure for the BAe 146. The first deliveries should occur in the summer of 1982, and three more will be scheduled for the following year.

It must be remembered that several non-British companies are involved in the program and its risks. Avco Corporation of Nashville is making the wing section and Saab-Scania of Linköping, Sweden, is making the tail assembly.

Two versions of the plane are planned (see technical description in our issue No 785 p 42). The BAe 146-100 can carry 71 to 93 passengers depending on layout, and the slightly longer 200 can accommodate 82 to 109 passengers. The first BAe 146-300 will be the eighth to come off the assembly line in Hatfield, and initial deliveries of this model will take place in early 1983.



The main landing gear, with a retracted twin-wheel following the concept of "everything-inside-fuselage", offers a relatively limited track which will restrict the use of the craft under strong crosswinds. The tires are low-pressure.



This rear view of the aircraft shows details of the tail assembly, whose elevators and rudders are all equipped with trim tabs. Note arrangement of inboard flap guides, which do not seem as illogical in this view as in the first photo.

11,023
CSO: 3102/308

TRANSPORTATION

ATR 42: REGIONAL TRANSPORT DESIGNED FOR ECONOMY

Paris L'AERONAUTIQUE ET L'ASTRONAUTIQUE in French No 88, 1981-3 pp 19-22

[Article by P. Pebereau: "A Regional Transport Plane Designed for Fuel Economy: The ATR 42"]

[Text] Spectacular fuel cost increases and the introduction of deregulation in the United States have changed the situation of regional air transport in recent years and have brought turboprop planes back into the limelight. Major companies are showing increasing interest in these planes, on their own behalf or on behalf of their domestic traffic affiliates.

Faced with these developments, Aerospatiale began in 1977 to explore the idea of a turboprop small-capacity cargo plane. In 1978, these studies led to the initial stage of configuration research for a regional transport plane. In 1977, a second preliminary definition stage produced a deeper study leading to the definition of the AS 35. Finally, in 1980, the ATR 42 design resulted from a cooperation with Aeritalia, whose AIT 230 project was dictated by the same goals.

Among all the criteria considered in searching for a configuration adapted to regional air transportation requirements, one priority was set right at the start of the ATR 42 project: cost reduction, to be obtained through:

Design and production at minimum cost;

Beyond investment costs, reduction of operations expenses, particularly through energy savings.

It is this fuel-economy aspect of the ATR 42 project which we propose to discuss, first of all by summing up the main steps taken for that purpose, then by comparing the ATR 42 with various methods of regional transportation, all in terms of fuel savings.

Fuel Economy in ATR 42 Concept

The goal of fuel savings involves steps in the areas of aerodynamics, weight, engines, and propellers. Results of these steps for the ATR 42 are outlined in figure 1.

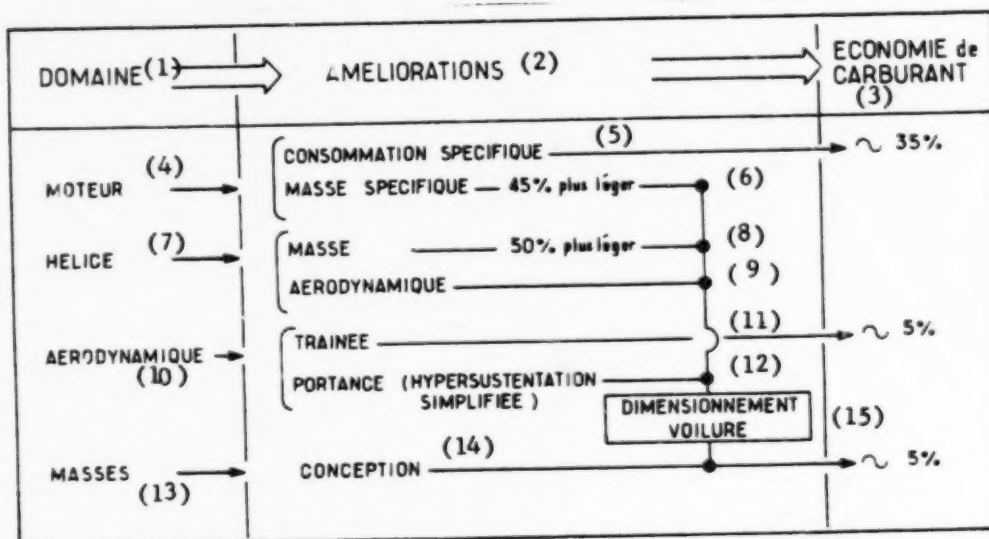


Figure 1. Technological Impact

Key:

1. Area
2. Improvements
3. Fuel savings
4. Engine
5. Specific consumption
6. Specific weight - 45 percent lighter
7. Propeller
8. Weight - 50 percent lighter
9. Aerodynamics
10. Aerodynamics
11. Drag
12. Lift (simplified lift augmentation)
13. Weights
14. Design
15. Wing dimensioning

Aerodynamics

Studies carried out over several years by Aerospatiale on subcritical modern profiles have produced an original ATR 42 profile offering the following characteristics:

Low drag;

High maximum lift making it possible to dispense with leading-edge lift-augmentation devices;

Low diving torque, resulting in reduced trim drag.

This profile, equipped with rotating, lift-augmented wing flaps (with fixed deflector), makes it possible to simultaneously attain the goals of low cost and reduced weight (simple kinematics), as well as high performance.

At the same time, special studies were conducted to find configurations which would improve the overall drag (karman, undercarriage fairing, pods.)

Finally, various applications of advanced technologies are planned, to further improve the fuel savings:

Local adaptation of wings to aerodynamic flow in propeller wake;

Optimization of wingtips;

Generalized active control.

Weight Reduction

This is obtained in particular through the use of modern composite materials in secondary structures and moving parts.

Engines

The ATR 42 is offered in a basic version with Pratt and Whitney of Canada PT7A-2R turboprops, an engine of recent design whose certification is expected in June 1983, and whose specific consumption is 20 to 30 percent less than that of turboprops presently in use, for a specific weight which is nearly 50 percent lower.

It will also be available with other engines under study by:

General Electric: CT7-9 which would be perfectly suited to the ATR 42 and would yield an estimated 7 percent savings on specific consumption compared to the PT7A-2R, but which is not yet definitely ready;

Turbomeca.

Propellers

The accepted propellers use a new design approach, benefitting from technological advances made at Hamilton Standard or Dowty Rotol:

Modern profiles which contribute improved low-speed efficiency and noise reduction;

Composite materials leading to 50 percent gains in overall weight.

Position of ATR 42 Compared to Various Regional Transportation Methods

Aerospatiale has conducted an in-depth comparative study of the various kinds of regional transport; in terms of energy consumption. The results of this study are shown in figure 2 which gives, as a function of straight-line airport distances between two points, the oil equivalent grams (gep) per passenger-kilometer transported (pkt) as well as door-to-door times.

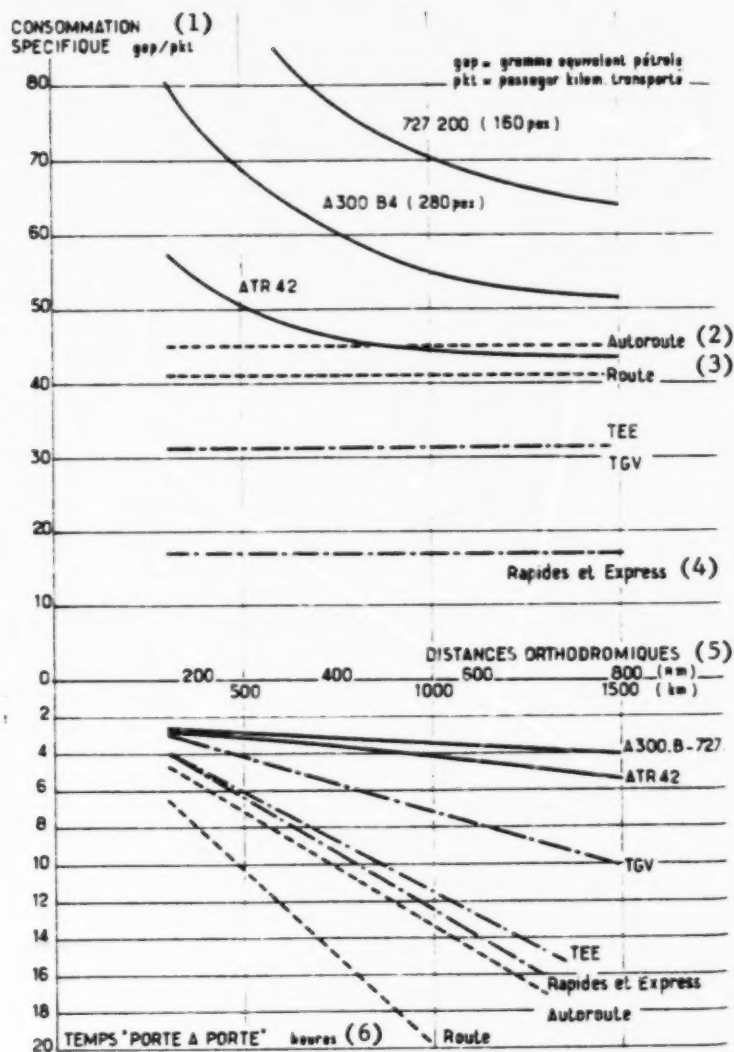


Figure 2

Key:

1. Specific consumption
2. Freeway
3. Road
4. Rapid and express transit
5. Straight-line distances
6. Door-to-door time - hours

These curves take into account various hypotheses for each type of transport, concerning:

Real distances covered with respect to straight-line distances;

Full speeds;

Additional delays attributable to travel time (city-airport or city-freeway, loading and unloading delays);

Loading coefficients.

This study brings out the fact that strictly from the point of view of specific consumption, railways are still the most economical by far. However, planes specially conceived for regional transport, such as the ATR 42, are relatively economical given the advantages they offer. The ATR 42 does not consume more than an average car on the freeway for distances over 500 km. If on the other hand travel time lapsed is taken into account, it should be remembered that a one-day business trip cannot be reasonably undertaken beyond a radius of 200 to 300 km on the freeway, or 300 to 400 km via rapid or express transit, or 400 to 600 km via TGV (high-speed train), while a plane can cover distances of up to 1500 km, in addition to which it is free of any natural obstacles.

Position of ATR with Respect to Competition

This comparison excludes turbofan planes which are penalized in terms of energy savings by the high specific consumption of their engines. Figure 2, however, indicates the position of the ATR with respect to the 727 or the Airbus.

Figure 3 shows, for a flight of 200 nm, the fuel savings of the ATR 42 against competing planes in the 30-50 seat range currently in production, newly launched, or in the planning stage. To make the comparison, we selected the basic version of the ATR 42 (42 passengers at 32" spacing).

The documentation for newly launched or projected planes was taken from press articles published about them.

The comparison discloses the following:

ATR consumes less than 50 percent of the fuel required by planes of the previous generation;

The craft is remarkably well positioned with respect to its competition in terms of consumption per available seat;

Particularly against planes of the same generation, DHC8, EMB 120, SF 340, with comparable engine technology, the ATR 42 retains a 15 to 20 percent advantage.

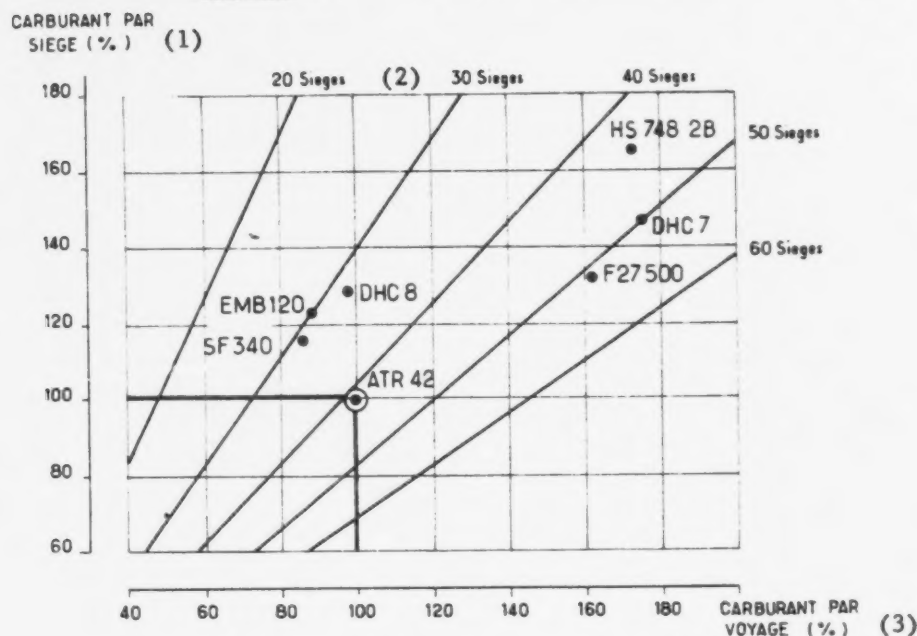


Figure 3. Comparative consumption per seat. Distance of 200 nm.

Key:

1. Fuel per seat (percent)
2. Seats
3. Fuel per flight (percent)

Future of Turboprop Planes

These few comparisons show the advantages of the ATR 42 in terms of economy for the basic version (42 passengers at 32" spacing); these advantages are further enhanced in the economy version (46 passengers at 30" spacing). But the ATR 42 is only the first step in a new line of very economical turboprop planes.

Even now, a lengthened version is planned, to bring capacity to 54 passengers at 34" spacing, and 58 passengers at 30". The plane's structures were conceived for this extension from the very beginning, and the engine power will be increased after placement in service (Pratt and Whitney of Canada is already offering a power increase of over 30 percent with the PT7 A 2R/1).

Engines using modern technologies, in the 5000-7000 hp, may become available by the end of the 1980's.

At the same time, propellers are being improved: high-performance propellers already make it possible to equip planes reaching a mach number of the order of 0.65.

Engines and propellers could thus make it possible to envisage, toward the end of the 1980's, airplanes capable of carrying 80-1000 passengers at relatively high speeds.

Fuel savings achieved in this way with respect to turbojets, amount to 30-50 percent depending on the speed under consideration.

Finally, Aerospatiale is engaged in exploratory studies with propfans, that is, with planes whose propellers can reach of mach number of nearly $M = 0.8$.

An important feasibility program is underway, aimed particularly at the following: propeller aerodynamics and structure, propeller-wing interaction, and cabin noise level, which would be unacceptable without special handling.

The problems to be resolved are major and difficult, and their solution cannot be anticipated for industrial application before the 1990's.

11,023
CSO: 3102/309

TRANSPORTATION

RENAULT DELIVERS FIRST EVE PROTOTYPE TO ENERGY AGENCY

Paris LE MATIN in French 20 Jun 81 p 16

[Article by Philippe Hazan: "Renault's EVE: 4.1 L/100 km"]

[Text] Yesterday, Renault formally delivered its first EVE (Element for an Economic Vehicle) rolling laboratory to the Agency for Energy Conservation. The car was ordered in July 1979. With a mileage of 4.1 L/100 km, it is remarkable for its aerodynamic quality.

Almost 2 months later than Peugeot's VERA, Renault delivered yesterday to Jean Poulit, Director of the Agency for Energy Conservation, the first prototype of its EVE. This laboratory on wheels (two of which have already been manufactured) is not, as is the case with VERA, a variation on an existing model (the Peugeot 305 for VERA). It is a true prototype designed as such (in spite of some technical similarities with the R18) and whose initial objective is research on fuel economy. Another difference with VERA is that Renault's engineers at the Billancourt factory have deliberately decided not to tamper with the intrinsic characteristics of the power plant, which is that of the R5 GTL, or to make very serious attempts at weight reduction, since they were handicapped by the overdimensioning of existing parts. On the other hand, a considerable effort was made in the area of aerodynamics research, since numerous tests at the Saint-Cyr-l'Ecole wind tunnel have resulted in a .239 drag coefficient (CX) which is up to .318 on the VERA, although it must be noted that VERA is a modified production vehicle. Esthetically, EVE is quite different and the inside space is about the same as in a R18. Tests at the Montlery track have yielded a consumption of 5.45 L at 120.3 kmph (Renault claims 5.5 liters), and 3.8 L/100 km at 89.4 kmph. These figures therefore correspond to the standards verified by UTAC at the request of Renault and the Agency for Energy Conservation. It is interesting to note that whereas VERA's performance characteristics were improved, EVE's were reduced as compared to an R18 TL or GTL except for the maximum speed which goes to 157 kmph from 150 kmph. It is unfortunate that we were unable to test drive the car to try its road-handling characteristics since it seems that the microprocessor control (which improves mileage by instantaneously selecting the gear ratio and throttle setting at all times) makes handling touchy at first. Renault is now working on a second generation EVE which will be equipped, among other things, with an optimized diesel engine. Meanwhile, Renault is planning to put on the market in the near future a turbo-diesel Renault 30—While we wait for the new R9!

6445

CSO: 3102/318

TRANSPORTATION

AIRBUS INDUSTRIE HEAD DISCUSSES CONSORTIUM'S FUTURE

Paris L'USINE NOUVELLE in French 28 May 81 pp 52-54

[Interview with Bernard Lathiere, managing director of the Airbus Industrie consortium, by Antoine Thiboumery and Alain Pauche. Date and place not specified.]

[Text] Bernard Lathiere, 52 years old and managing director of the Airbus Industrie consortium for the past 5 years, wants to double Airbus' success. Five hundred planes will be sold this year, and 1,000 during the next, he predicts. What counts now for this likeable man, who frequently refers to his provincial roots and his village in the Haute-Vienne, is reaching the stage of 2,000 airplanes! "It's my main objective," he tells L'USINE NOUVELLE. Reappointed as managing director for another 5-year term, Bernard Lathiere broadly surveys the European and international aviation industry and reveals his strategy for the new airbuses at a time when the 34th International Air and Space Exhibition is opening next week at le Bourget (June 4-14).

[Question] Have you noticed an important change in the aircraft industry?

[Answer] Yes, there have been two major developments, which in fact tend to lead to opposite effects. First of all, we have become the second builder of commercial aircraft in the world, following Boeing. We have passed McDonnell Douglas and Lockheed! In most of the big contracts, it comes down to us and Boeing. Recently, for example, we have signed three contracts in the Middle East, and the last competitor we had to beat was in fact Boeing, with the 767.

The second development is that it is now the customer who is coming to us. This is a basic change for us. Boeing knows that its main competitor is no longer McDonnell Douglas or Lockheed, but Airbus Industrie.

[Question] Aren't you afraid of being the cat's paw for Boeing?

[Answer] No, because companies are now very careful about the overall cost of a plane. The Airbus was sold to Lebanon, for instance, because this plane is found in most countries in Asia and Europe, whereas the Boeing 767 is clearly not as widespread!

[Question] In the United States, doesn't this argument work against you in the end?

[Answer] That's true. Despite this, Eastern Airlines chose our plane in the United States simply because it is more economical than the Boeing. All the same, it seems that today's market is distributed as follows: the U.S. market is still dominated

by American companies; in Europe, Airbus Industrie has the edge; and, finally, the Third World is open to all companies. But I should stress the fact that we are in a relatively good position in these regions.

[Question] Are you currently affected by the air transportation crisis?

[Answer] No, absolutely not. Moreover, the air transportation crisis is not an economic crisis per se. It is a financial crisis: if the number of air passengers has not declined and if airlines' business continues to grow, then it is the income per passenger that has decreased. What are the reasons for this decline in the rate of return? First, fierce competition (deregulation, as the Americans say) has led to an abnormal reduction in fares. At the same time, the cost of fuel and personnel have been constantly on the rise. Today, for example, fuel accounts for 40 percent of a company's costs. A few years ago, it was only barely 10 percent! This trend was in our favor in the beginning: when fuel costs run too high, we have to change planes.

This is partly why we sold more than 200 Airbus A-300 in 1979. The crisis, however, has not always played in our favor. The Swedish airline SAS, for instance, recently cancelled two options. Others have asked us to delay delivery of their aircraft by 6 months to 1 year.

[Question] Haven't the airlines changed their strategy? It seems that they are now choosing more small-capacity planes than the large carriers?

[Answer] That's right. Just 2 years ago, all the airlines wanted us to build a large Airbus, an elongated A-300 with a capacity close to the DC-10, i.e. 320 to 350 seats. Today, the trend has reversed. They are attracted by smaller planes. So we are happy to offer them the A-310.

[Question] You recognize the importance of being able to offer two different planes, the A-300 and the A-310. But don't you think that your line is a little skimpy all the same?

[Answer] That's one of our basic policy aims, to have a full line.

[Question] More specifically, how is the Airbus Industrie line going to develop? Are you going to launch a large four-engine Airbus first, or a small twin engine craft?

[Answer] Let me remind you that we were the first in Europe to have realized the need to build a family around the Airbus. Just the opposite was done with the Caravelle! We have the A-300 with 250 seats and the A-310 with 210 seats. At the same time we have been working on three new designs for the past few years.

Let me clarify things. The issue is not which of the three we are going to build. We will make all three planes! The issue rather is which of these three planes we will decide to manufacture first.

First, we are studying an elongated version of the Airbus. It will be christened the TA-9. It will be a long to medium range plane equipped with two engines and not with three like its competitors. It will carry 320 passengers and 30 containers, or as much as a Boeing 747! This airplane is going to make our competitors unhappy: operating costs will be 25 percent less than for the three-engine jet now in service.

Then we have on the drawing boards a four-jet engine long-haul aircraft with 200 seats, the TA-11, with the same body as the A-310. This plane is different from the Boeing 747. It will be equipped with CFM 56 type engines, with 10-12 tons thrust. But we are also ready to equip it with the equivalent Pratt and Whitney or Rolls Royce engines. Whatever happens, two things are sure: we can build these two planes with the same wing, which obviously means substantial savings, and we will be launching them at the same time.

[Question] You spoke of a third plane?

[Answer] The third is the one everyone is talking about, the A-320. We are planning two versions: the A-320/100 and the A-320/200. The first will have a 143-seat capacity and the second 163 seats. So this plane will not in any way be competing with the Boeing 737, but with the Boeing 727 instead. Here we have a clear competitive edge since, with two engines, we can transport 15 to 20 passengers more than the Boeing 727!

[Question] What do the airlines think of this?

[Answer] The airlines seem to be interested more in the smaller planes than the larger ones. Our decision is in fact in their hands. If three or four companies are ready to make a commitment with us to be the first to buy either the A-320/100 or the A-320/200, that's the one we will launch. If, however, their choice runs to the TA-9, TA-11 pair, that is what we will make.

The choice of the companies to introduce the planes is crucial. We must in fact find a good formula which will enable us to achieve a sufficiently broad coverage of the market. What good is it to make a single plane for one airline, as was frequently done in the past?

[Question] On the issue of engines, don't you think that you could favor or give preference to the CFM 56 engines, since they are manufactured jointly by SNECMA [National Aircraft Engine Study and Manufacturing Company] and General Electric?

[Answer] It is not our business to sell SNECMA-General Electric engines. Our business is selling airplanes. Of course, if our customer should want French-American made engines besides, we would be delighted. But that is not our primary concern. On the contrary, in order to sell planes, you have to offer a maximum choice to the airlines. This means that you should be neutral in the choice of engines. Up to now, it has always been this way.

[Question] What is your objective in launching these four new airplanes?

[Answer] Our aim in increasing the Airbus line is to double the odds! About 40 airlines have currently ordered the Airbus A-300 and A-310 from us. In both firm orders and options, this represents more than 469 planes. We should exceed the target of 500 this year. Taking into account the lifespan of the A-300 and the A-310 and the airlines' needs, we know that we should sell a total of more than 1,000.

[Question] You could thus repay the money loaned by the governments?

[Answer] For the A-300, government loans will be fully reimbursed with the delivery of the 360th aircraft. We are delivering the 135th at present, and as soon as we finish the 150th, repayments will amount to \$3 million a plane. In fact, we began repayments with the delivery of the first airplane. This is proof that Airbus will not be in a deficit position.

[Question] What is the budget for launching the A-320?

[Answer] Between \$1 and \$1.5 billion in research and development. You will recall that the A-310 cost \$1 billion.

[Question] When will you decide to launch this new program?

[Answer] The management of Airbus Industrie must first submit its choice to the board of trustees. If it's approved, the governments involved will be solicited to obtain the necessary financial aid. Our target is to bring the new plane out towards the end of 1985 or the beginning of 1986. This means that we will have to make our choice before the end of this year. Our decision should be made by the board around next September or October.

[Question] Will the division of responsibilities among the partners be the same?

[Answer] There is actually a good chance that the division of labor will be different from what it was for the A-300 and A-310.

[Question] Is it true that the Germans have reservations? And aren't you afraid that the consortium which worked so well for the first two programs might break up?

[Answer] A lot has been said and written to the effect that the Germans are not interested in the new program. This is completely untrue! What is true, however, is that they will probably not participate to the tune of 37.9 percent as they did before.

In that case, it is possible that the English, who currently have 20 percent, will increase their share. Aerospatiale may likewise ask for a larger share. It now has 37.9 percent.

[Question] Who will manufacture the wing? Who will handle the final assembly? Who will make the frame?

[Answer] This is of no importance from an economic standpoint (only from a chauvinistic one). Personally, I could not care less whether the assembly line is in France, England, or Germany.

[Question] All the same, you are obviously aware of the impact of this!

[Answer] Since I have been at Airbus, one of my main efforts has been to keep this airplane from becoming political, because political planes never take off!

[Question] You would leave the choice up to the firms?

[Answer] At the present time, Aerospatiale is handling the final assembly at Toulouse. Will it continue with the assembly, or would it prefer to work on the aerodynamics of the wing span, which is an equally important job but one at which it has less experience than the English? There is no obvious answer. In the same vein, would the English prefer to continue specializing in the aerodynamics of the wing span, a speciality which they would lose if they opt for the assembly? The important thing is for each one to have a sufficient workload.

[Question] Is it true that you have contacted the Japanese? Could they join the Airbus Industrie consortium?

[Answer] It is true that we have begun negotiations with them. But these negotiations have not progressed very far.

[Question] What is your purpose in contacting the Japanese, since their aviation industry lags behind the European's?

[Answer] You are right. Their industry is not at the same level as the European industry, but it is not as backward as people say. They can offer us many things. First, relatively low production costs and organizational know-how.

In fact, we are holding discussions with a group of industrialists which already has a 15 percent share in the manufacture of the Boeing 767! In short, what we are looking for with the Japanese is a long-term marriage.

[Question] Are you also interested in a cooperative arrangement with the Americans?

[Answer] With the Americans, it's more difficult. They have not yet exactly understood what we mean by a cooperative arrangement. The thing we're talking about subcontracting.

[Question] What could a cooperative arrangement with the Americans offer you? In any case, you couldn't be thinking of Boeing?

[Answer] That would raise a general outcry! But there are other aircraft companies in the United States. What we could expect from a cooperative arrangement with an American firm such as General Dynamics, for example, is an opening on the overseas Atlantic market. It's an enormous advantage to have an American company among your associates.

[Question] Let's come back to production aspects. Aren't you a little disappointed to see Airbus' production rate increase so slowly?

[Answer] It's true that production is increasing at a rather slow pace. But we can't do anything else. If we were to step up our delivery schedule--and we could of course decide to do this tomorrow--this could affect the quality and reliability of our aircraft, which would be catastrophic. If we are in fact able to hold our own vis-a-vis the three companies which have most of the world market, it is because our product is better than theirs. We have to keep this up. We are in any case going to quintuple the production rate in a few years from two to ten planes a month!

Today Airbus Industrie gives jobs to less than 15 percent of its partners' employees, or about 20,000 persons, whereas the total is about 160,000. By 1985 there will be 40,000 to 45,000 employees working on Airbus. At that time, the production rate will be ten planes a month. That will represent nearly 25 percent of the total staff of the consortium.

In summary, if you want to maintain a high quality, you cannot increase your personnel too much.

[Question] Should we conclude that Airbus Industrie doesn't have the means to make products other than those we see today? Doesn't this also mean that a military version of Airbus will not be appearing anything soon?

[Answer] You know, we are just barely able to produce a sufficient number of commercial aircraft. If we had to produce 50 military planes as well! No, I think wisdom dictates that we maintain our original goals.

[Question] What is Airbus Industrie's current market share and what position do you intend to have in the future?

[Answer] If you look only at that segment of the market covering the medium-range wide-bodied planes such as the DC-10, the Lockheed 1011 and to a certain extent the Boeing 767 and even the 747, our position a little more than a year ago was between 51 and 52 percent. For this year, we should end up around 49 to 50 percent. We therefore have about one-half of the market.

Overall, we already controlled 21 percent of the market in 1979. What is important is that however you calculate our position, we always come out ahead of Lockheed and McDonnell Douglas combined. That was our goal.

9805

CSO: 3102/295

TRANSPORTATION

BRIEFS

CN 235 ORDERS BEGIN--A short time after having announced the launching of joint production of the CN 235 commuter airliner (AMI No 803, p 46) [Spanish] CASA and [Indonesian] Nurtanio have taken 54 firm orders and 18 options. [Text] [Paris AVIATION MAGAZINE INTERNATIONAL in French 1-14 Jul 81 p 17]

CSO: 3102/339

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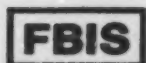
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19 August 1981

West Europe Report

SCIENCE AND TECHNOLOGY

No. 69



FOREIGN BROADCAST INFORMATION SERVICE

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19 August 1981

WEST EUROPE REPORT SCIENCE AND TECHNOLOGY

No. 69

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BIOTECHNOLOGY

BRIEFS

GENETIC RESEARCH ADVANCES IN FRG—At the nuclear research center (KfK) in Karlsruhe a first important step was taken in the area of genetics towards an understanding of the regulation of genes by hormones, that is to say, of a process which, with others, is responsible for the formation of hereditary characteristics carried in genes. Hormonal control was observed for the first time in mouse cells with an experimentally transplanted tumorigen, a hereditary trait responsible for causing cancer. This tumorigen, which is present in all mice, usually has no harmful effects. It is "negatively controlled" through intercellular processes, its influence is suppressed. However, it can be activated through the effect of X-rays or chemical mutagens—chemical substances that affect hereditary characteristics—and initiate the formation of a cancer, in this particular case breast cancer. The astonishing discovery was that the gene became active when transplanted from one cell to another. It was further established that the presence of a certain hormone, the so-called dexamethasone from the glucocorticoid group, is necessary for this activation. Basic genetic research in Karlsruhe has its foundations in the longer-term goal of contributing to the understanding of the effects of minute doses of radiation, in which mainly changes in the activity of certain genes is suspected. [Text] [Duesseldorf VDI NACHRICHTEN in German 24 Apr 81 p 33] 9581

INTERFERON FROM ELF-AQUITAINE—Sometime during this year "Sanofi SA," the pharmaceutical subsidiary of the Elf-Aquitaine group, plans to begin production of interferon. Sanofi will not market the interferon itself, but place it at the disposal of the French Ministry of Health. At the same time the company is working on another cancer agent, which is produced with the aid of platinum and has the possibility of causing fewer side effects than the chemotherapeutic drugs currently in normal use. [Text] [Deusseldorf EUROPA CHEMIE in German No 11, 1981 p 171] 9581

SIMPLE PRODUCTION OF PROTEIN -- In biotechnology, the industrial application of biological knowledge, more and more applications are being found for enzymes. Enzymes are proteins which allow a certain reaction to take place some million times quicker than its natural speed. Willi Kullmann, of the Max Planck Institute in the FRG, reported a surprising finding in the manner in which enzymes can be used. Kullmann built on methods which are already in use. In laboratories two amino acids are

often bound together (this is then called a dipeptide) by using enzymes which normally /break down/ [*in italics*] proteins. In such a case, this kind of enzyme -- the proteinases and the peptidases -- are forced to "work backwards," thus to join together instead of separating. Now Kullmann is the first to have proven that it is possible with these enzymes to build short amino acid chains (small proteins) consisting of more than two amino acids. Kullmann achieved this remarkable result with a molecule which acts in our brains as a kind of painkiller: encephaline. For several years now, the manner in which this matter works has been the subject of research. Kullmann's discovery has in any case provided researchers with sufficient quantities to experiment with. The big advantage of backward working enzymes is that the products do not have to be made synthetically. The enzymes work at room temperature, no unwanted chemical by-products are created (enzymes are, as the phrase goes, specific), and the product is of precisely such a chemical combination as is required for the enzyme reaction. The new alternative will undoubtedly find useful applications in industry. JOURNAL OF BIOLOGICAL CHEMISTRY, Vol 225, p 8234. NEW SCIENTIST, Vol 88, No 1231, p 706. [Text] [Huizen AARDE & KOSMOS in Dutch Apr 81 p 201] 8463

CSO: 3102

CHEMICALS

BRIEFS

OFFSHORE ICE PLATFORM--Stockholm--A petroleum platform using ice as construction material: A Swedish firm has found a solution to the problem of reducing the construction costs of offshore petroleum drilling platforms by more than one-half by using ice instead of concrete as material. The Stal Refrigeration Company, whose headquarters are at Norrkoepping (200 km south of Stockholm) has developed a platform project in which the steel reinforcement would be encased in ice instead of poured concrete. Stal Refrigeration hopes to begin construction work for the first platform, which will require 3 million tons of ice, next year and is looking for an appropriate construction site. This must be located at the mouth of a river because fresh water must be used since it is easier to freeze than salt water. The platform, whose construction should take about 3 years, will then be towed to the drilling site. [Text] [Paris AFP SCIENCES in French 7 May 81 p 34] 11706

CSO: 3102/333

ELECTRONICS

NEW CIRCUIT-ETCHING PROCESS SAVES MATERIALS

Stockholm NY TEKNIK in Swedish 29 May 81 p 16

[Article by Lasse Sandstrom]

[Text] A new process for recovering copper from the etching of printed circuit cards has been developed by a Gothenburg company, MX Processer AB. The advantage of the process is that it is closed—both the copper and the etch bath can be continually recycled.

Printed circuit cards are used in most electrical devices. The cards are produced by covering a plastic disk with copper. The copper is coated with a pattern that is etched onto the card in a solution of ammonia water. The unwanted copper is removed. The etch bath works only until it reaches a certain saturation, after which it must be replaced with a new solution. Where the used liquid goes is not known.

It Works Like This

The new method is a hydrometallurgical process called solvent extraction. Briefly, it works like this: The saturated etching solution is treated with a kerosene solution. The kerosene contains an organic substance that has the ability to form a compound with the metal that must be removed from the etch bath. The result is an organic copper compound.

The kerosene solution with the copper compound is then treated with sulfuric acid, after which it undergoes electrolysis and pure copper is deposited on a titanium electrode. The etching solution is returned to the etching process, the sulfuric acid is reused, and the rinse water is treated in the same way as the etch bath. The water leaving the plant is clean.

The Mecer Process, as it is called, has been tested for several years in Gothenburg. Everything has worked well and 94 percent of the etching solution has been recycled.

This development work has been underway for 2 years and it is supported by STU (Board for Technical Development) and Gothenburg's Development Fund, among others. MX Processer has joined with Transaco Maskin AB for commercial production. So far, LM Ericsson, Gylling and Luxor have installed Mecer plants.

Angry Manufacturers

Of course, etch bath manufacturers are angry and have tried to prevent the Mecer Process from entering the market. Among other things, they have reduced the price of etch baths drastically. MX Processer believes, however, that future prospects are good, especially because of the unique recycling possibilities.

9336

CSO: 3102/348

ENERGY

FRG'S COAL CONVERSION PROGRAM UNDERGOES CHANGES

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 1 Jul 81
p 5

[Article: "Better Prospects for Brown Coal Refinement?--Budget Cuts in Hard Coal Refinement Programs"]

[Text] TN. Frankfurt, 30 June--In the period of 1974 to 1980, a total of DM 2.5 billion in public funds were provided for coal research and refinement. The old medium-term budget of the Federal Ministries of Research and Economics for the period of 1981 to 1984 provides an additional amount of DM 2.6 billion for the coming years. However, cuts are imminent here, too. The German-American-Japanese coal liquefaction projects in the United States was one of the first victims of the new budget cut policy; this project was abandoned permanently. Whether current budget figures for coal research and refinement can be maintained is questionable. In view of the lack of funding they might be reduced even further. The Federal Ministry of Economics is concentrating on support measures for coal refinement plants and has already designed corresponding guidelines. The necessary funds are lacking, however, because the Ministry of Economics plans on spending a total of DM 820 million of the 1981 to 1984 coal refinement budget of DM 1.3 billion.

The originally optimistic expectations regarding an expansion of the German coal refinement program on the basis of hard coal have been drastically curtailed in the meantime. Contributing factors were not only climbing coal prices, but also the large amounts of funding required for the construction of these plants as well as their operation, if German hard coal is relied upon. It is only with massive subsidies that a maximum of one plant using German hard coal can be financed with the funds provided. Brown coal refinement, however, could become economical if developed by the respective companies with funds of their own. The same applies to imported coal, for which respective applications of potential sites have been received.

In addition, international cooperation through the construction of coal refinement plants at the source of more reasonably priced coal, for instance in Australia, is another alternative. Due to the problems of transportation on the world coal market, the implementation of a large coal refinement program on the basis of imported coal does not seem likely in the foreseeable future. Instead, there is a tendency towards constructing refinement plants at the source and transporting the refined coal products to the FRG.

9544
CSO: 3102/317

ENERGY

MBB DELIVERS SOLAR POWER PLANT TO KUWAIT

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 3 Jun 81 p 5

[Text] According to statements from MBB (Messerschmitt-Boelkow-Blohm), the 100-kilowatt solar power plant "Sulaibyah" in Kuwait, which the company delivered, is the first solar thermal plant in the world to use spot-focusing parabolic collectors. It is also the first order from a foreign customer placed with German industry in the field of solar plants to generate power and process heat. The plant, which began operation in March 1981, has now been dedicated and is being tested by MBB and the Kuwait Institute for Scientific Research (KISR) in a trial program lasting several years. Because of the importance of the project in the Arab world, it has the support of the Ministry for Research.

Users of an agricultural test station are being hooked up to the plant gradually. The solar plant is providing energy for an agricultural test station in the arid region Sulaibyah. Pumping stations, irrigation systems, cooling plants, desalination plants and greenhouses are being operated with the thermal and electrical energy generated. Sulaibyah uses the so-called farm system, with 56 parabolic collectors. The thermal energy generated in the collectors of about 400° Celsius is partially transformed through a turbine with organic Rankine circulation and air cooling into electrical energy. The remaining thermal energy is used to operate absorption cooling into electrical energy. The remaining thermal energy is used to operate absorption cooling plants and a multistage desalination plant.

As the principal contractor, Messerschmitt-Boelkow-Blohm is responsible for overseeing the system (choosing the concept and design), and in addition for the development of the parabolic collector field, including the tracking system, as well as for supervising the project during the construction phase in Kuwait. As a contractor, the Kuwait Institute for Scientific Research is in charge of planning and preparation of the entire infrastructure, and additionally of carrying out the laying of pipes in the fields, including thermal storage. As a subcontractor of MBB, Linde is responsible for technical development of the machinery and delivery of the turbine.

9581

CSO: 3102/330

ENERGY

NEW CONCEPT IN WIND-ENERGY TECHNOLOGY: MULTI-MILLS

Huizen AARDE & KOSMOS in Dutch Jun 81 pp 334-336

[Article by G.J. v. Lonkhuyzen: "Multi-Mills, a Playable Card"]

[Text] "You have to imagine what is actually going on in such a large mill -- wind energy generator. A very long, thin blade is whirling in the wind. Enormous forces are working on this blade. Moreover, the blade is only attached at one point, at the axis. Major forces are also at work there. It will definitely take years yet before the technique and technology of such a large wind turbine have been mastered." These comments were made by engineer T.H. Potma, president of the Energy Conservation Center in Rotterdam, at the presentation of a new project: the multi-mills.

A multi-mill is a tower with "balconies" at various heights; the windmills are at the ends of these balconies. But they are small mills, with a blade diameter of no more than 5 to 15 meters. The balconies are naturally moving with the wind.

The idea for such a mill has been launched. Documents relating to it have gone to the Ministry of Economic Affairs and to the energy experts in the House. Thus, the first step has been taken. The second step will involve: the ministry's decision to order a detailed study of the project.

The Center has gathered good references: there are at least three enterprises -- all of them in Zeeland -- which are interested in such a multi-mill.

The Netherlands Energy Research Center [ECN] is also very interested.

Everything 'At Home'

In order better to be able to understand the idea of this multi-mill, it would be helpful to look for a moment at the large windmills in the world. AARDE & KOSMOS has already described the windmill at the ECN site in Petten, the Danish Nibe-mills, the Danish Tvind-mill and the American MOD-2 models, to name only the largest ones. They are all testing and measuring models. Because even the MOD-2 -- in spite of the fact that it has been installed for practical use -- still serves primarily to produce a large amount of measuring data, which can be incorporated in the designs for future models.

All those large mills have yet to prove that the technique of the very large blades, 20 meters or more, has been mastered. A few of them even seem to indicate that for the time being this technique has not yet been mastered. It is different for small mills. In this respect, the Danes are the world leaders. They have already marketed quite a number of small models. But this is also true of the Netherlands. There, the windmills of Lagerwey and Van de Loenhorst (also discussed in AARDE & KOSMOS) and that of Polenko seem to be satisfactory. This means that the Netherlands has mastered the technology for the ECN project. This does not apply only to the wind turbine itself, but also to the concrete construction, the steel constructions, the electronics, and the engine and generator techniques. Hence, a multi-mill could be built entirely as a Dutch project and would turn the Netherlands at one blow into the leading nation in the world for the development of wind energy systems.

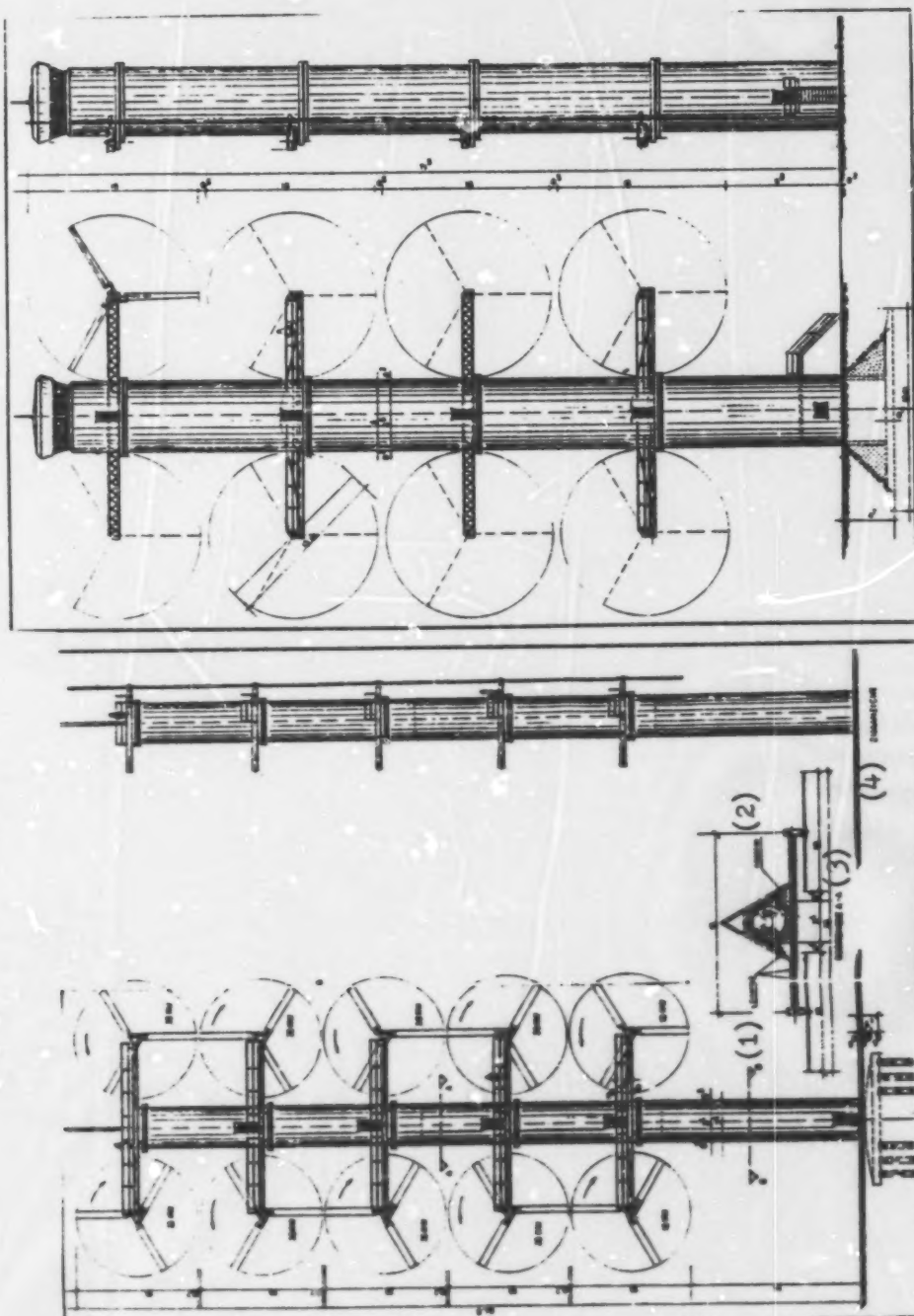
As a matter of fact, once it can be produced in quantity, such a construction would cost approximately 900,000 guilders and would produce 600,000 kilowatts per year, enough for a good sized city area (300 houses). This would amount to 10 cents per kilowatt. The national average is 20 cents. These figures are the result of theoretical calculations. The mill has not yet been built and hence, no current has been delivered as yet. Reverses have not been taken into account, and different market situations for the building and the components cannot be estimated either. On the other hand, there is the fact that the calculations were not based on unclear and unknown factors; all the components of the project, from funding to blade construction, and from investments to subsidies, are known in our country, and this is what is important.

Idea of Van Deijl

It was engineer T.J. van Deijl of the Center who put the multi-mill on paper. He designed a "10 model" and an "8 model." The tower with 10 windmills is equipped with smaller turbines than the one with 8. But that is not a necessity. Everything depends on the choices that are made. Because the energy generation is dependent on the wind, the characteristics of the wind must be taken into account.

The wind blows more strongly at higher altitudes than at lower altitudes. Hence, as a rule the windmills will not all turn at the same speed. Therefore they must work independently of each other. The highest windmills, for example, produce 35 kilowatts, the next balcony 30 and thus continually less, down to the lowest one which produces 15 kilowatts. Electronically, this does not pose any problem at all.

Another aspect is the fact that occasionally the wind does not blow. Considering that the windmills are being used to generate electricity and that it is hard to store electricity (batteries are unprofitable and moreover, they are very, very heavy when it concerns large storage facilities), lack of wind is a problem that needs to be tackled differently. Water power has been considered. As there is a large concrete tower in any case (height approximately 60 meters), it would be possible to use this tower as a water tower also. During windy periods, the mills could use their surplus energy to pump water up to a large container at the top of the tower. During periods of calm, this water could be made to fall, and this power could then drive turbines. In this manner, a period of a few hours could be bridged without difficulty.



Figures 1 and 2: Two designs for multi-mills. The "8-tower" has been designed for a production of 415 kilowatts per hour, and the "10-tower" for 270 kilowatts per hour. The 10-tower was not designed haphazardly. A theoretical client, a refrigeration company, was considered.

Key:

- 1. guardrail
- 2. grating

- 3. cross section A-A
- 4. side view

Consider Reality

In any case, multi-mills will never be able to become the sole source of energy, because periods of calm can last longer than 1 or 2 hours. Therefore, the Center sees a need to modernize the whole energy system of the Netherlands in the direction of a new philosophy, cogeneration (combined generation of heat and power), in order to make the use of fossil fuels as efficient as possible. With cogeneration, the heat released by the generation of energy is not wasted via the cooling water, but used, for example, for city heating.

Hence, there will be a continued need for conventional electric power stations, and then specifically for the quick starting power stations. They are the power stations using oil, gas and coal, because nuclear power stations are neither quick starting nor can they be regulated.

The fact that all the necessary technology is available in the Netherlands is not the only attractive aspect of the idea of multi-mills. The idea also has the advantage that it would be beneficial to Dutch enterprises. Numerous other projects, such as large windmills and magnetohydrodynamic generation, involve technologies which are also being developed by other large countries. Hence, there is a good chance that foreign enterprises will market these techniques, even if they are made possible by a Dutch invention. In terms of large blade techniques, American companies -- such as Boeing and Hamilton Standard -- already have a substantial lead. The only difficulty left is that a non-technical problem stands in the way of Dutch initiatives. We actually do not have a sound program for the development of small windmills. The large windmill in Petten has swallowed up 8 million guilders. Only half a million guilders are available for small scale research, while it is precisely in this area that interest exists. Hence, significant initiatives must come from the private sector and this is how it has always been up to now.

8463

CSO: 3102/344

ENERGY

BP TO DEVELOP COAL DUST-OIL MIXTURE FOR STEAM GENERATION

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 4 Jun 81 p 7

[Article: "Up To 50 Percent Coal Dust in Heating Oil"]

[Text] In the next 2 years British Petroleum plans to spend up to £25 million to develop a process through which industry's dependence on heavy heating oil for steam generation is to be reduced, reported the NEW SCIENTIST (No 1250/1981). Alex Groszak, of the BP research center in Sunbury, said recently at the congress of the Royal Society of Chemistry (RSC), that the company's goal was to deliver stable suspensions of oil and finely ground coal abroad, beginning in 1983.

For this purpose, BP is remodeling a former cement factory near West Thurrock in Essex, at a cost of £5 million, for the annual production of 100,000 tons of coal/oil suspensions. The necessary process was developed in Sunbury. It is based on combinations which occur in natural coal and create a suspensive stability requiring no extra additives or stabilizers. During the past 3 years BP has been running tests at its refinery in Grangemouth, Scotland, using the suspension to generate process heat and has also run the steam generating machinery in the turbine of the oil tanker British Hazel on it.

Groszak also told the RSC congress that the tests had contributed to the development of a relatively economical process by which up to 50 percent finely ground coal could be bonded with heating oil. The suspension burns almost without residue. Companies whose firing plants are set up for heavy heating oil could thus save the substantial costs associated with the machinery for removing solid residue, if coal is burned along with the oil. In the BP process, conventional soot blowers, with which the firing plants are cleaned, are adequate to remove the residues.

The basic idea behind the coal/oil suspensions is by no means new. Shell calls its own version "Colloil." Until now these isolated systems have not proved themselves, because they were not stable enough. Until 1970 mineral oil was also so cheap, compared with coal, that the manufacturing costs of coal/oil mixtures were not justifiable. But today the price of heavy heating oil is already more than twice that of coal from various sources, and with a further increase the use of coal dust to "stretch" oil could be more economical than replacing oil-fired installations with coal-fired ones.

9581

CSO: 3102/330

ENERGY

BRIEFS

TEST FACILITY FOR COAL LIQUEFACTION--A scaled-up test facility has gone into operation in Bottrop with Ruhrkohle AG (RAG) owning 60 percent and Veba Oel AG 40 percent of the plant. The facility is expected to process 200 tons of hard coal into 30 tons of light and 70 tons of medium coal oil in addition to 20 tons of liquid and heating gas a day. Veba intends to refine these products in its neighboring Scholven Refinery in Gelsenkirchen to heating oil, diesel and carburetor motor fuel, synthetic gasoline and heating gas. About 20 percent of the capital cost of DM 226 million were spent on pollution control equipment. The plant employing 215 workers will cost DM 65 million a year to operate. The Nordrhein-Westfalen Land Government has agreed to assume 90 percent of the capital cost. [Text] [Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 14 Jul 81 p 5] 8664

THINNER SOLAR CELLS--A solar cell with an active layer 0.03 mm thick has been produced by the technical universities in Aachen, Karlsruhe, and Stuttgart. The layer is produced by the vacuum deposition of silver and cadmium sulfide onto a glass plate. The plate is then dipped into a bath in which the cadmium sulfide is converted to copper sulfide. A circuit layer of copper is then applied and a conductive pattern is etched, which is then electroplated with gold. A pilot plant for producing the solar cells is being built by the Nukem Company in Hansau. The price is estimated at about 2 DM/W with series production. The efficiency of the solar cell is 5 percent. [Text] [Stockholm NY TEKNIK in Swedish 21 May 81 p 17] 9336

GROWIAN CONSTRUCTION BEGINS--Brunsbuttel (FRG)--Construction of the world's largest wind power plant in FRG--Work on the world's largest wind power plant started on 15 May on the banks of the Elbe in Schleswig Holstein, in the northern part of FRG. The plant, known as Growian (Grosse Windenergieanlage), will have an electrical power of 3 megawatts. Growian, which should go in service in the fall of 1983, will be composed of a tower nearly 100 meters in height, topped by a rotor with two blades, each 50 meters long. As soon as local winds reach a force of 4, the rotor will be activated and will power a generator installed at the top of the tower. Growian will make it possible, for example, to provide heat for a community of 400 inhabitants. [Text] [Paris AFP SCIENCES in French 21 May 81 p 26] 11,023

CSO: 3102

INDUSTRIAL TECHNOLOGY

PEUGEOT: AMONG MOST MODERN ASSEMBLY LINES IN WORLD

Paris L'ARGUS DE L'AUTOMOBILE in French 21 May 81 p 5

[Article: "Peugeot: Modernization of Production Centers; Mulhouse: An Assembly Plant Among the World's Most Modern"]

[Excerpt] Are you familiar with "the tooth"? It is the latest assembly line for the [model] 104 installed by Peugeot in its Mulhouse plant and its name is derived from the fact that upon the plan view of the plant it resembles a tooth. That was made official when a proud molar nearly 2 meters tall was erected in the garden adjoining this ultra-modern assembly line!

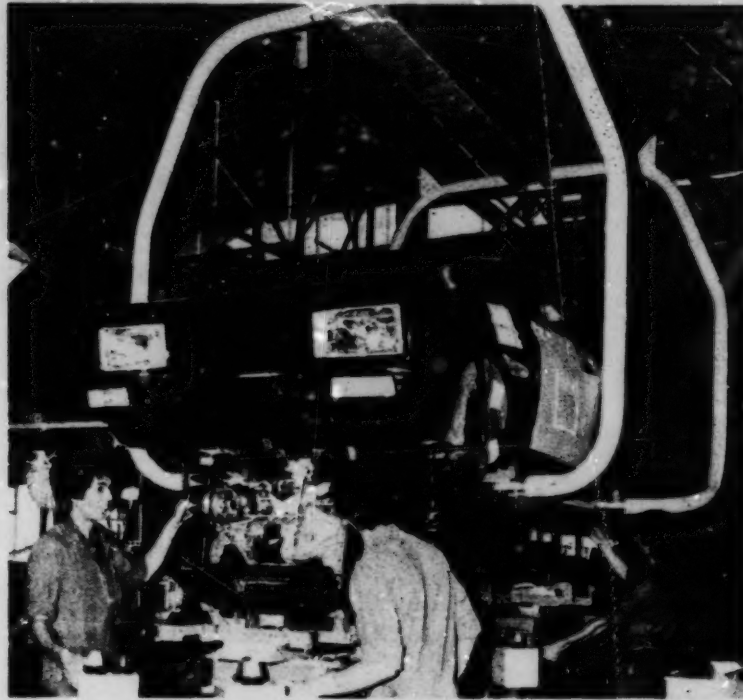
On the face of it there is a desire to bite...the competition, therefore to produce the 104 under the best possible physical and humane conditions. After a tour of the entire world, in which nothing taking place in Europe, the United States, and Japan was overlooked, the technical officials at Mulhouse came back, satisfied that they were right, to construct what they had designed... before they left.

Without going into technical details the principal improvement incorporated in this assembly line is that it no longer includes an endless conveyor. The conventional system of a conveyor carrying the body has been eliminated and replaced by "boats," a kind of large holders encircling the body, which are suspended from a rail. The latter can be adjusted to three levels very quickly, facilitating work over, within, or under the vehicle being assembled. At the same time all feeding of parts and finished components has been redesigned in the same way; the work plan is much more untrammelled, congestion diminished, and handling simplified. Multipurpose, the assembly line can assemble any model at all with very great flexibility, thanks to judiciously arranged "buffer zones."

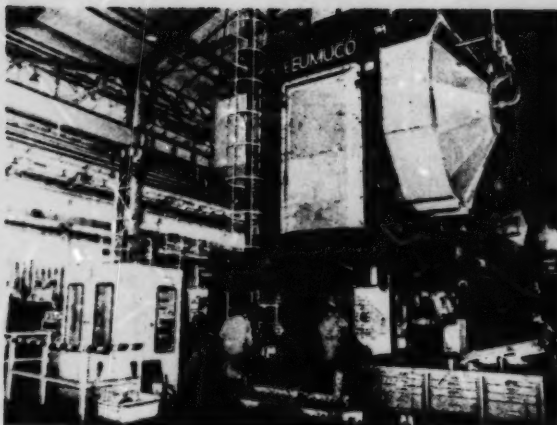
The factory is bright, painted in lively colors (including the "boats"), the lighting natural, entering through the glass panes in large bay windows (and this is a novelty) in the walls. It is completely clean, well reflecting the interest in their working tools taken by those who use them. Safety conditions have also been improved: there no longer are overhanging carriers or conveyors on the ground. The latest innovation in this pilot unit--the personnel participate in the organization and expresses its opinions in "contract meetings": it is in this manner that the daily production objectives are defined, the

production rate established in accordance with the factory's desires, the "buffer zones" making the stations less dependent upon each other.

Definitively organized for only a short time, "the tooth" has been broken in by producing the 104Z "plus," turning out 300 vehicles per day, but obviously is hoping for a spurt in sales to show what it can do. Everywhere this "small" Peugeot which will revitalize the brand is obviously being awaited.



The key station: "the tooth"; the engine and rear axle being assembled to the body



Mulhouse is an ultra-modern plant. At left, the automated aluminum foundry; at right, the new painting robots

11706
CSC: 3102/333

INDUSTRIAL TECHNOLOGY

NEW ROSENLEW ROBOT FACTORY OPENS IN FINLAND

Helsinki HUFVUDSTADSBLADET in Swedish 10 Jun 81 p 11

[Article by Marten Kevin]

[Text] The Rosenlew Company's new building for the "robot tailors" is now complete in Ulfsby, just outside Bjorneborg, where the company has previously produced its "mechanical people." The total area is about 1,700 square meters. The salaried employees have already moved in and in early August after the vacation period full production will begin. Certain parts will still be made in Bjorneborg. Almost 60 people are employed in the robot division, of which about 25 are salaried employees.

Director Matti Korpinen of the company's tool factory believes that robot production has a promising future for Rosenlew. To be sure, this sector of the company has not yet become profitable overall, but it is a new activity that has required large investments for product development. It began in 1973 and the first robot was delivered in 1976 to Kemiras Vihtavuori Ammunitionsfabrik. So far, the trend promises to be good for the future.

Last year sales amounted to about 10 million marks, of which about 70 percent were the result of exports. This year's budget provides for sales of 17 million marks. It is estimated that exports will rise to about 80 percent.

In this case, the employees may well be called "tailors," since the robots are produced according to the special needs of the customers.

Rosenlew delivered robots to the much-discussed Valco picture tube factory, which was later shut down. The product development work which Rosenlew invested in the picture tube robots made the company an expert in this field. Last year the United States was the largest purchaser of such robots. This year has been a slower, in-between year on the American market due to lower investments, but next year is expected to be better.

This year Sweden is the largest foreign purchaser of robots for use, for example, in the machine and auto industries. Rosenlew is interested in a wider range of robots and not just in the picture tube sector. In Sweden robots are also used in bakeries. They are also being used increasingly, for example, in the graphics business and probably in the brick industry.

Working Conditions Too Stressful

Director Korpinen stated that Rosenlew's robots are used mostly for special working conditions that are characterized, for example, by especially heavy work, heat, dust, or high risk. With regard to picture tubes, he said that they are difficult to handle.

Of course, there is competition in this area. Because of its realibility, Rosenlew has been able to compete, for example, with picture tube robots produced by American industry's own automatic sections. Good quality is a decisive factor.

With regard to series-produced robots, Japan represents a competitive danger, but fortunately the Japanese are less interested in "tailor-made" robots. Such robots are needed at present in picture tube plants.

There are companies in central Europe, primarily in West Germany, that make tailor-made robots in modules.

Rosenlew has not yet gained a foothold in the Soviet market. There the demand has been met by production within the Council for Mutual Economic Aid, where Bulgaria has been especially chosen to produce robots. Next year the company's machine tool factory will be presented in the Soviet Union at a symposium in Moscow.

There are plans for a dramatic increase in the use of robots in various countries, including England.

Thus, Rosenlew is looking forward to a growing market. Production will not "sky-rocket," however, even though the company now has a large, new facility. The increase is also determined by training of additional personnel.

Special seasonal demands on the availability of personnel result from the fact that installation of robots occurs most often during vacation periods. Director Korpinen also points out that knowledge of foreign languages is required of those who work hard.

9336

CSO: 3102/345

INDUSTRIAL TECHNOLOGY

BRIEFS

SENSOR-GUIDED WELDING--A new sensor control for protective-gas welding robots is being introduced by Masing-Kirkhof GmbH (6057 Dietzenbach 2). According to the company, the range of utilization of industrial robots of this kind is extended considerably by means of this system, which was developed by ESAB in Sweden. The company states that the sensor permits the robot to detect seams within a tolerance range of approximately plus/minus 5 mm and trace them. Deviations in dimensions occurring during welding because of the rheological properties of the metal have thus far prevented the robot, which works with an accuracy of plus/minus 0.2 mm, from welding these parts, says the company. As in the past, they had to be welded manually. According to Masing Kirkhof GmbH, the ring sensor which has now been developed is suited for tactile seam detection as well as for tactile seam tracing, although the latter applies in the dragging gun position only. The company states that the sensor can be used with any welding gun, because no influencing factors, such as welding equipment and plate thickness, have to be taken into consideration. [Text] [Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 1 Jul 81 p 5] 9544

CSO: 3102/317

SCIENCE POLICY

NEW FRENCH RESEARCH MINISTER PLANS CHANGES IN ORGANIZATION

Paris AFP SCIENCES in French 27 May 81 pp 1-2

[Text] A "Mega Ministry:" Research and Technology

Paris--On 26 May during a press conference Jean-Pierre Chevenement, the minister of research and technology, revealed that he intended "to consolidate under his guardianship most of the major technological development and research organizations" that belonged to various ministries under previous governments.

Involved, among others, are organizations such as the Atomic Energy Commission (AEC), the National Center for Space Studies (CNES), the National Institute for Research on Data Processing and Automation (INRIA)--previously under the guardianship of Industry--the National Institute for Agronomical Research (INRA)--formerly under the guardianship of Agriculture--and the National Institute for Medical Research and Health (INSERM)--formerly under the guardianship of Health.

Moreover, the National Center for Scientific Research (CNRS), which was under the guardianship of the Ministry of Universities, and the National Office for Research Evaluation (ANVAR), which belonged to the Ministry of Industry, will be reattached to the ministry directed by Chevenement.

This consolidation of organizations, the list of which is not "restrictive," matches the spirit of "breaking down divisions" preached by the president of the republic and the prime minister, according to Chevenement.

Chevenement indicated that the decrees authorizing his ministry could be issued very shortly.

One of his first actions will be to rescind the decree enacted by the former secretary of state for research, Pierre Aigrain, on the status of the 40,000 engineers, technicians and administrative personnel (ITA) of the major research organizations. The decree modified the employment, career and mobility conditions of these personnel.

The new minister confirmed that a "research planning law" would be set up and submitted to Parliament during 1982. It could take effect for the 5 years 1983-88. This law, Chevenement emphasized, "would guarantee the research package for 5 years," that is, it would avoid fits and starts in the financing of research. It would also aim at safeguarding the "equilibrium between basic and applied research."

A technological evaluation authority will be established in Parliament, as envisaged during the electoral campaign, in order to have the representatives participate in the country's major technological choices.

Chevenement also recalled that the government's objective was to raise the nation's research spending to 2.5 percent of the GNP in 1985 instead of 1.8 percent today. "It is a question of putting an end to the atrophy of French research since 1968," he affirmed.

The minister stressed, however, that he plans to "change as little as possible and not to interrupt anything abruptly." This choice is "also the government's," he stated.

"This ministry must not be an unwieldy administrative structure, but it must not be created unless it has the machinery to operate," he declared.

He admitted that the problem of boundaries could arise with other ministries because of this consolidation, especially as far as military and aeronautical research are concerned, but that, in any event, "research missions" attached to the ministries should continue to exist.

On subjects like "informing society," the minister indicated, without commenting, that the new government did not have the same concept of this problem as the previous one.

The first concrete result: this large ministry will have at its disposal premises larger than those of the former secretary of state for research on Rue Saint-Dominique. As a matter of fact it is settling into the Hotel de Clermont, the former headquarters of the Ministry of Youth, Sports and Leisure, 29 Rue de Varenne, in the eighth district.

The new ministry, despite its size, should not be an unwieldy administrative structure but rather a body for controlling the budgets of the different organizations and for coordinating in order to protect the planning law, the minister stated. Thus the DGRST [General Delegation for Scientific and Technical Research] "will not exist in a different form," Chevenement indicated. In fact, all that would change would be the Delegation's research policy, which would be quite different from that conducted previously.

All these problems were mentioned by the new minister, who called together the "Committee of Wise Men," 16 representatives of the major research organizations, on 26 May.

9380

CSO: 3102/346

SCIENCE POLICY

BRIEFS

FRG-IRAQ ECONOMIC-SCIENTIFIC COOPERATION--Bonn--German-Iraqi economic and scientific cooperation agreement--The Iraqi vice prime minister, Taha Yassin Ramadhan and the West German minister of foreign affairs, Hans-Dietrich Genscher, signed an economic and scientific cooperation agreement in Bonn on 26 May. This agreement is the first of its kind that Iraq has signed with a Western partner, the German source indicated. [Text] [Paris AFP SCIENCES in French 27 May 81] 9380

CSO: 3102/346

TRANSPORTATION

A-320 PROJECT OFF TO GOOD HEADSTART

Paris AFP SCIENCES in French 4 Jun 81 p 45

[Article: "Twenty-five Countries Represented at the 34th Aeronautics and Space Salon"]

[Excerpt] The gigantic showplace of the worldwide aerospace industry which opened its doors on 4 June at Le Bourget, holds the products of 25 countries.

A total of 793 exhibitors are present and more than 220 airplanes will be shown on the ground and in flight during the Salon which is to be inaugurated officially by Francois Mitterrand.

In the area of transport aircraft few genuinely new airplanes will be shown, except for the McDonnell Douglas DC-9 Super 80 and British Aerospace BAE-146. Nevertheless, for prospective replacement, within the next 10 years, of fleets which have become too expensive and too noisy, manufacturers will take advantage of the Salon to unveil their future airplane projects for the very promising market for 150-seat short range transports. Thus, on the first day of the Salon Bernard Fathiere, general manager of Airbus Industrie, announced that the A-320 project had been started; this airplane will be a short range transport of 130 to 150 seats, and will be available at the end of 1985 or beginning of 1986, Fathiere stated.

"For a year we have been working very seriously on the 'small Airbus' project. At the last meeting of the board of directors of Airbus Industrie held in Seville in April we were authorized to speed up the studies and to propose delivery dates, price schedules, and even contracts to airline companies.

"Therefore, we are the first. Now, it is no longer that we need only airline orders for start-up," Fathiere continued, making allusion to 150-seat airplane projects in the process of being defined by the competitors (Boeing and Fokker-McDonnell Douglas in particular).

11706

CSO: 3102/364

TRANSPORTATION

FRENCH, GERMANS PLAN INTERCHANGEABLE AUTO PARTS

Paris L'USINE NOUVELLE in French 16-23 Jul 81 pp 37-38

[Article by Georges LeGall: "Automobile Equipment--The Standardization Weapon"]

[Excerpts] Faced with the economic crisis and imports, automobile manufacturers and equipment suppliers have a stake in fighting the same battle. Standardization, by lowering costs of production and maintaining inventory, and by facilitating improvement of quality, will enable the Japanese challenge, and, tomorrow the American, to be repelled.

Overall, the financial situation of the automobile equipment suppliers has deteriorated. "From 1979 to 1980 the cash flow fell from 6.1 percent to 4.6 percent of sales," it was pointed out by M. d'Andert, the general Manager of the FIEV [Federation of Vehicle Equipment Industries]. The equipment suppliers emphasize, with bitterness, that the automobile manufacturers are increasing the selling prices of their vehicles much more rapidly than the prices at which they purchase their equipment.

"They are always seeking the lowest prices." This is somewhat a criticism, by the suppliers, of the manufacturers for what they wish. The latter deny it, Robert Lansard, Manager of SOGEDAC (a company which has been making all purchases for Peugeot, Talbot, and Citroen since the end of 1980) states: "Our primary objective is to assure supplies of quality, in quantity, and on schedule, to the factories. Only then are we concerned with prices. Certainly the two concerns are related; if we impose additional requirements it is expected that we pay the price. But, with equipment bought for the manufacturers, as with consumer goods purchased by the general public, what is most expensive is not necessarily best. In fact, we must make a judicious decision, strike a compromise called the quality/price ratio."

Certainly the manufacturers strive to obtain equipment of high quality at lowest prices and in these regards the Japanese performance tends to serve as the standard of reference. That is inevitable in order to face competition whose pace is quickening. In this battle the manufacturers and equipment suppliers actually have a common interest, for together they enjoy the successes or suffer from the reverses of the French automobile industry. They have, moreover, understood this well since they decided one year ago to establish five joint committees charged with dealing with the following problems: standardization, quality, productivity, expenditure authorization, and distribution of detached parts.

Standardization is a fundamental question because it affects, in large part, the progress which can be achieved as far as quality and lowered costs of manufacturing and maintaining inventory are concerned. It is comforting to find that a good start has been made and that agreements are not limited to the two French groups (Peugeot and Renault) but that they also involve Volkswagen.

The first phase of the standardization committee's work has been concerned with starters, alternators, motor-fan units, cooling systems, and jacks; starting next September the work will deal with brakes, shock absorbers, clutches, windshield wiper motors, electric door locks, oil filters, digital clocks, horns, batteries, and safety belts. In the beginning of 1982 the task forces 3 and 4 will probably set to work. The objective is to complete the task in 1983.

Spectacular Expansion of Standardized Production

The stakes are great because the present diversity in equipment is astonishing (the Peugeot group uses 60 alternators, Renault 100 radiators, etc.). Standardization is going to enable the number to be reduced drastically: for example, in 1983 it is probable that the range of new radiators at Renault will comprise only three basic models; indeed, the new Renault which will make its debut in France this autumn (it will also be assembled in the United States by American Motors in 1982) will have a radiator which includes subassemblies also entering into the radiators in service at Volkswagen. The result is spectacular expansion of standardized production runs.

Thus, Michel Carrie, general manager of Valeo, points out: "Up to now our maximum production rate for windshield wiper motors has been 300 per day of each model. Our new model, which can be used upon a full range of vehicles, has been adopted by Renault and Talbot; it has been approved by Audi, and Volkswagen is interested. For this produce we foresee a production rate of 8,000 to 9,000 per day."

Expansion of standardized production runs will bring about reduction in cost prices on the order of 15 percent to 20 percent, thanks to automated manufacture. But it will have repercussions on the level of employment and promote continued concentration of enterprise.

With its advantages and disadvantages it is nevertheless the path to which the Europeans must inevitably commit themselves in order to repel the Japanese challenge today, and the American tomorrow.

11706
CSO: 3102/364

TRANSPORTATION

LOW-FUEL 'UNI-CAR' PROTOTYPES UNDER CONSTRUCTION

Duesseldorf VDI NACHRICHTEN in German 22 May 81 p 19

[Text]



A model (scale, 1:5) of the experimental "Uni-Car" sedan, a group development of the technical Universities of Aachen, Berlin and Darmstadt and the Research Institute for Vehicles and Vehicle Engines in Stuttgart. In the project, which is sponsored by the BMFT (Ministry of Research and Technology) particular importance

is placed on low fuel consumption, pedestrian protection and noise emissions. Prototypes are under construction and with a 2.5-liter, 4-cylinder turbocharged diesel engine they have a maximum fuel consumption of 6.7 liters/100 kms in the combined city/highway cycle; the coefficient of drag $C_d = 0.254$.

9581

CSO: 3102/314

TRANSPORTATION

VW OFFERS GROUP OF DEVICES FOR GASOLINE ECONOMY

Paris AFP SCIENCES in French 21 May 81 p 26

[Article: "VW Formula E: At Last, Some Serious Economizers"]

[Text] "E" as in Economy: VW is thinking of nothing else now, and is launching on the market a series of vehicles offering an economy option. Under the label of Formula E, the market will be offered the following models: Polo, Derby, Golf, Jetta, Passat, Audi 80, and Audi 100, in both gasoline and diesel versions, all of them equipped with fuel-saving devices.

Original

They can be classified in two groups: the passive one includes aerodynamic and mechanical devices, while the active one involves the driver.

Passive: Whatever the driving style, front spoilers or rear fins, or aerodynamic improvements of various types, all reduce consumption.

Engines with high compression ratios and electronic ignitions serve the same purpose. On the other hand, the use of a very high fourth or fifth gear, labelled "E", is being challenged by other technical designers (at BMW especially), because in normal use the consumption is often higher than with the former gear ratios. Engineers at VW are also aware of this, and this is why they are adding active devices which tend to modify the driver's behavior, thus enabling him to take full advantage of the vehicle's improvements.

The originality of Formula E consists in this complementary approach to economy driving, which remains optional: nothing prevents a driver in a hurry from driving in racing style or from reaching peak speeds in third or fourth while ignoring the E gear.

Engines

A believer in regular gasoline, the VW group is now abandoning it: gains achieved with high compression ratio engines (therefore with high-test gasoline), are now greater than those obtained by burning less expensive gas (the difference between regular and high-test has remained constant while prices have climbed dizzily.)

The Formula E Polo, Golf, and Jetta have been equipped with a 1093 cm³ engine (69.5 x 72 cm) whose compression ratio has gone from 8/1 to 9.7/1. The power, 50 hp/DIN, does not vary, but it has to be obtained with high-test, and at 5000 instead of 6000 rpm. On the other hand, the torque rating, essential for maneuverability, will increase from 7.9 mkg at 3500 rpm to 8.4 mkg at 3400 rpm.

In order to maintain full performance with the Passat and Audi 1600 engines for some time longer, they have been provided with breakerless ignition.

Gear Boxes

With the 3 + E and the 4 + E gear boxes, maximum speed is reached with the next-to-last ratio, the highest ratio being stretched for economical driving.

For the 1600 engines (Volkswagen Passat, Audi 80 and 100), the same 4-speed box ratios have been retained, and a fifth E-gear has been added, stretching the transmission which will now produce 38.7 km/h at 1000 rpm against 27.5 km/h (or + 40 percent in the case of the Passat.) Thus, at 90 km/h, the engine speed will drop from about 3300 to 2300 rpm, and at 130 km/h, from 4700 to 3400 rpm. At the same time, the unchanged maximum speed will thus be reached as before, in fourth, accelerations not being affected since the ratios for the intermediate gears have not been changed.

However, gear ratios for models at the bottom of the line (Polo, Golf, Jetta) have been redesigned. Given the greater flexibility of the 1100 engine, it was possible to divide the transmission into three ratios instead of four. This means that third gear now has practically the same characteristics as the old fourth gear (first is unchanged, second is longer, and third is 1.04/1.) Maximum speed is obtained in third gear. The new fourth, renamed E, is much longer (+ 30 percent), and represents the economical ratio for cruising at lower engine speeds; it also lowers the noise level in addition to reducing consumption and mechanical wear.

Driving Aids

The best-known because it is already factory-installed, is the consumption indicator, based on the intake vacuum. Since this information is not sufficient by itself, a computer integrates other parameters (accelerator pedal depression, engine speed, gear ratio) to indicate to the driver the best moment for shifting gears. When the yellow light (VW) or orange arrow (Audi) lights up in the shift indicator, you should shift immediately into the next higher gear so as not to burn too much gasoline.

The latest system is the Stop-Start. At a red light, you push a small button on the end of the windshield wiper control, and the engine stops. You depress the clutch pedal and step on the accelerator, and the engine restarts immediately. The real savings begin after a five-second stop, and are especially advantageous with large engines: the new 1100-cm³ consumes only 0.8 liters per hour at idle, and has not been equipped with this device.

All the improvements of Formula E have reduced consumption by 10 to 20 percent at 90 and 120 km/h, and by 20 percent in city driving. In addition, the shift

indicator and the Stop-Start bring the savings up to 26-29 percent in town! The cost of the Formula E devices, 1000 to 1500 francs, can be rapidly amortized in 10,000 to 15,000 km: for those who drive little, it is more economical than a diesel!

Convincing but Tiring

A brief test enabled us to check the effectiveness of Formula E, both on a Passat (in town) and an Audi 100 (on the highway.) The tests were carried out with Mobil's cooperation, and were therefore absolutely rigorous; they produced the following results:

City driving: 105 tests, average of 8.941 liters per 100 km.

Highway driving: 95 tests, average of 7.746 liters per 100 km.

Some reporters drive lightly, and others have a lead foot. The sample thus seems valid, demonstrating the value of the system.

On the other hand, it is quite exhausting to obey the shift indicator to the letter and to operate the Start-Stop. You either take off slowly (it takes time to restart the engine), or you wait with your left leg stretched (on the clutch) to rapidly start on a green light and not hold up those behind you: it is exhausting. On a hill it is practically impossible to abide by the indicator lights. Under strong acceleration the indicator light stays on only briefly or does not light up at all; this was intended so as not to distract a driver who has to pass in a hurry, but in fact you sometimes wait for the light in vain.

All in all it means learning new techniques, but when you know that the price of a liter of fuel will soon be raised by 40 to 50 centimes, you actually learn very fast!

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CSO: 3102/351

TRANSPORTATION

AUTOMATED ASSEMBLY OF BL'S 'MINI METRO' DESCRIBED

Duesseldorf VDI NACHRICHTEN in German 22 May 81 p 6

[Article: "Computers Help the British To Build Cars"]

[Text] The conveyor belt, once the great revolution in industrial production, is losing its terrors. The basic idea of carrying out only a few, identical operations at each work station remains, but today these operations can be automated--either by automatic welding machines or industrial robots. One of the most modern automobile plants in the world has now started production in Great Britain. With further technical developments, newer plants will be even more productive, but the sequence of events is typical.

With an investment of almost DM 1 billion, production facilities were built near Birmingham for 6,500 vehicles per week, or 300,000 units annually of the new British Leyland (BL) "Mini-Metro." According to those in charge at "BL Cars," the new plant will be a decisive step on the path to restoring the company's health.

Technical progress can be seen most clearly in a comparison with the "Mini," which has been in production for the past 21 years. Where 138 men were needed for the conventional manufacture of the Mini bodies, only 38 are required for the "Mini-Metro."

Twenty-four computers and more than 100 PC (printed circuit) control systems were installed in the new production plants in Longbridge. Hookups are made through a coaxial "Videodata" cable loop. It was developed in conjunction with the electronics firm Ferranti and laid in the entire factory area. All computers, terminals, light pencils and pieces of control equipment are tied into this 7-km long cable.

Most of the control systems are also in permanent contact with the BL data center in Redditch, where all the sales organization's information concerning orders is stored. The data center in turn supplies the main computer in Longbridge with instructions for production planning on the basis of orders received.

Large-scale production presupposes sophisticated monitoring of inventory. In the new factory, the electronic management system ensures optimal stocking and controlled feeding of all parts to production at the correct time for each. The main storage area itself measured 140 X 15 meters and contains more than 3,000 racks in 4 areas. The automatically guided rack transporters move among them on rails. The total capacity of stocks is sufficient for 7 1/2 days at full plant output. For 6,500 unfinished bodies that is several thousand tons of metal.

Data storage starts with the suppliers, whose small computers are in constant contact with the EDP (Electronic Data Processing) system at the Longbridge West factory.

Each pallet with pressed components is identified at the time of delivery to central inventory and reported to the computer by a controller with a light pencil. The computer automatically examines weight and dimensions to indicate the rack area and to deposit the material on the assigned shelf using the automatically guided transporters--again controlled by the central computer. When capacity is reached, a pallet is dispatched every 58 seconds and directed to the delivery ramp, where it is picked up by forklift trucks. The drivers receive instructions displayed on a screen where the pallets should be delivered.

Control of the flow of material and monitoring of stocks by computing machinery ensures that material is optimally stored, that pallets are turned around quickly before corrosion begins and that components can be retrieved if one of the rack transporters for one shelf area should be out of commission. For this reason, the same type of part is stored in several areas.

The raw body shell of the "Mini-Metro" is made up of 26 prefabricated assemblies, outer skin components and pressed parts for the fram. They are delivered on a new railroad line and by road from the BL pressing plants in Swindon and Llanelli, where new, modern pressing lines have been built. The largest of these individual pressed parts is the side, which is drawn in one piece.

Various processes are used at Longbridge West to assemble the individual parts. Subgroups, such as the side, front section and the floor, are made on special manufacturing lines. The prefabricated body parts are then joined in automatic locating fixtures and--also automatically--welded into single structure.

The largest individual automatic machines are two multipoint welding machines from Kuka in Augsburg.

Some assemblies have to be joined by shielded gaseous arc welding before they reach the Kuka machines. These important operations are performed by two Asea industrial robots. The CO₂ robots, operating in sealed cabins, work in five axes and make complex 150-millimeter long weld seams along pressed parts which will later carry the car's front subframe.

The entire body of the "Mini Metro" is then assembled on two 110-meter long conveyor belts (from Sciaky), each with three multipoint welding stations and industrial robots (from Unimation). First, the prefabricated assemblies have to be brought up and the floor, front section, sides and the trunk frame are attached with spot welds.

Before final welding, the spot-welded body goes into a holding area for 120 units. From here it returns to the conveyor belt into a hydraulic locating fixture, in which the individual parts are precisely fitted and joined with 72 spot welds. The roof is attached at the next station, joined to the rest of the frame with 140 spot welds.

The individual sheetmetal parts produce a rigid structure which is subjected to a tolerance check before it continues. Twenty-four critical dimensions are electronically examined, and the result shown visually on a screen. Simultaneously it is printed out for a second check. If the examination shows a deviation from the specified dimensions, the control plant automatically stops the line, so that the body cannot continue to the next robot welders. The inspector can override the stoppage for nine more bodies, but then "everything stops."

Once the raw body has passed its certificate of "fitness," it passes through another group of 14 robot welders, 2 of which act as roving welders, in case one of the other machines stops. Here another 250 spot welds are made, with an average time for each of 23 seconds. Some of the robots work more quickly than others, in the process the welding electrodes have to cover up to 16 meters in one welding cycle to make the welds on the outside and the inside of the body.

In each shift 1 or 2 bodies are taken to the airconditioned measuring room and measured at up to 124 points. These checks, which formerly required several days, are carried out completely automatically in a matter of a few hours.

Floor Pan Welded Together on the Line

The entire floor pan of the new "Mini Metro" is assembled on automatic welding transfer lines from three assemblies. Eight projection welds and 622 spot welds are made in the process. Only eight people work on the plant to feed and start it. The total cycle time is 42 seconds, so that up to 85 car floor pans can be completed each hour. The high degree of mechanization requires preventive maintenance.

For plants of this size, a utilization of 80 percent is assumed. However, it has been shown with manufacturers in Germany and Scandinavia that with trained maintenance crews and efficiency of over 90 percent can be achieved.

These short downtimes are made possible by using automatic storage containers. If one section of a line below a container stops, the preceding section continues to produce and fills the container. In the reverse case, the rest of the line is supplied by the bin. Complex plants like this require a high degree of interconnection, such as freely programmable control offers, allowing all the many subsystems (for example, for the three vertical and four horizontal storage containers) to be included. The control system also indicates where a malfunction has occurred, so that tedious searches for errors are avoided.

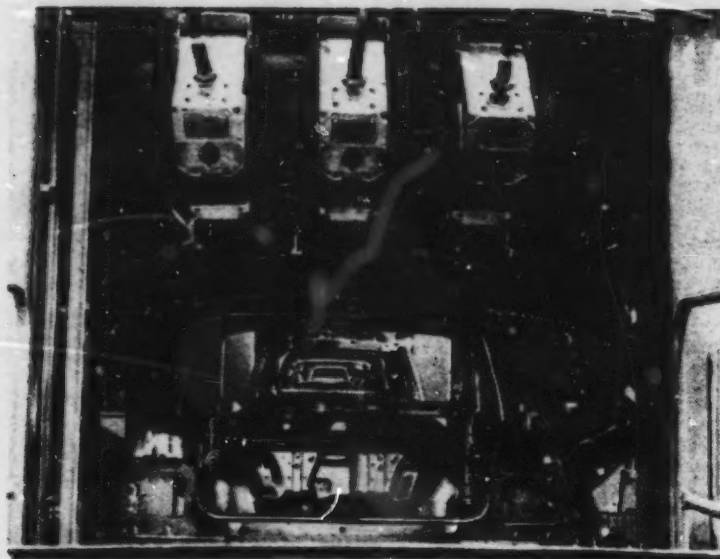
For safety reasons concerning the quality of the welded joints, only direct or resistance welds are used; this requires turnaround and turnover stations in the plants. Most of the individual components, as well as the trunk and central section are brought automatically to the line for the complete floor pan by means of circular conveyors. A shuttle system takes over the job of cycling parts between the welding stations.

At the end of the 58-meter long welding line, the complete floor pan is stood on end and passed on to a circular conveyor.

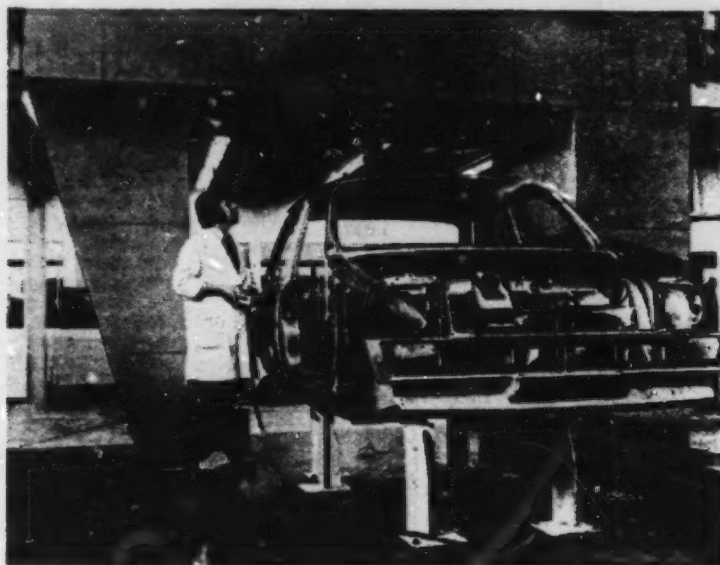
Two identical plants are needed for the planned production volume.



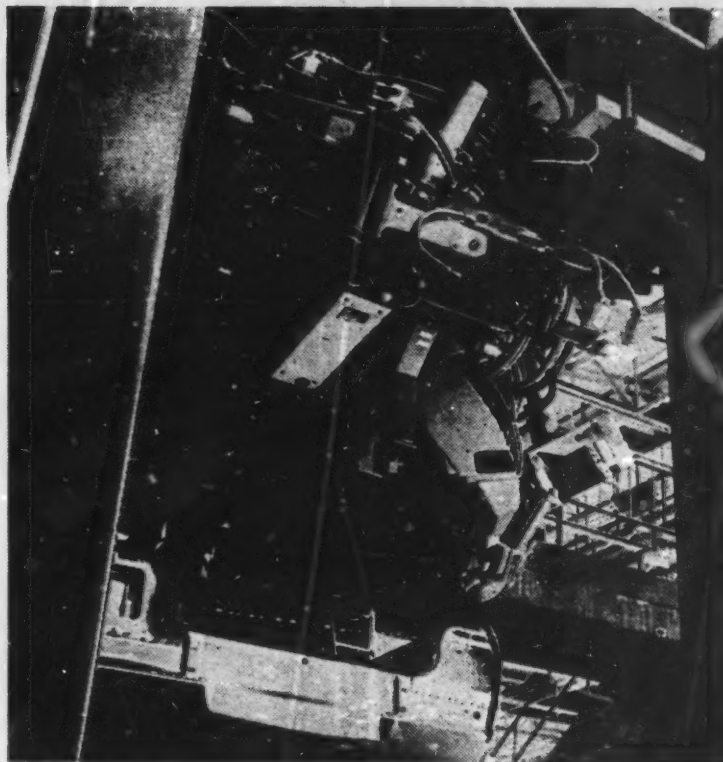
The floor pan subassembly of the "Mini Metro," consisting of three load-bearing sheetmetal parts, is joined together on an automatic welding transfer line (from Kuka). Four presses, 12 multiple welding stations and 5 loading stations operate in conjunction here.



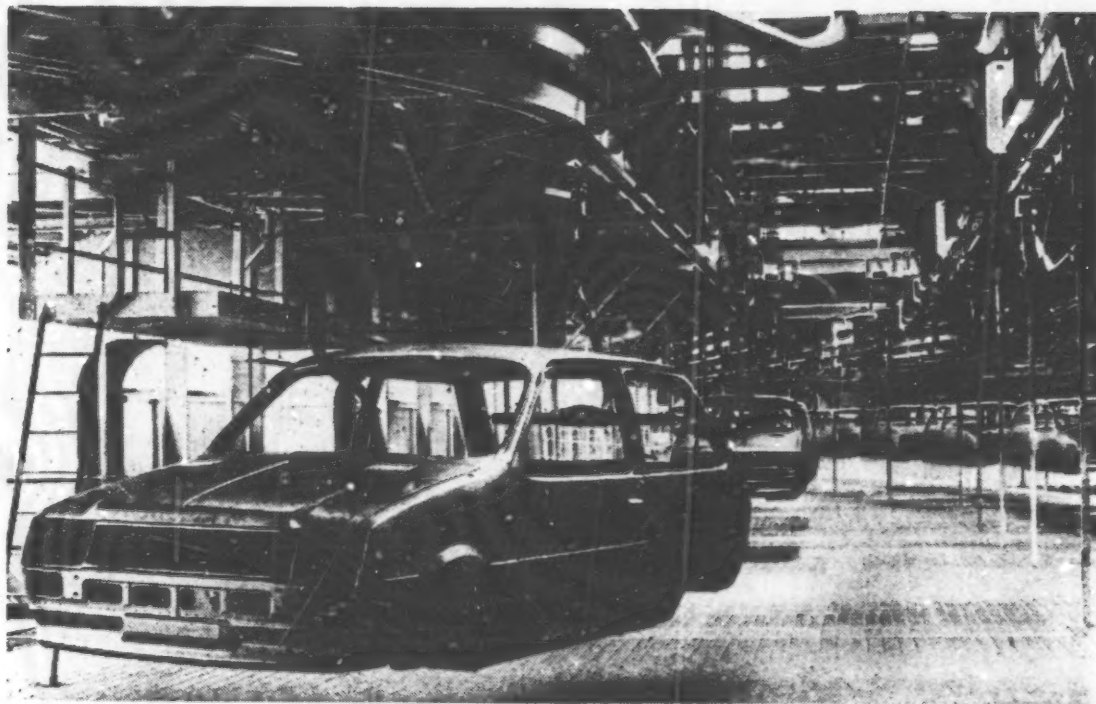
The separate parts of the Metro's body are carried to the individual assembly stations by automatic conveyors. At this station, the roof is being welded to the sides.



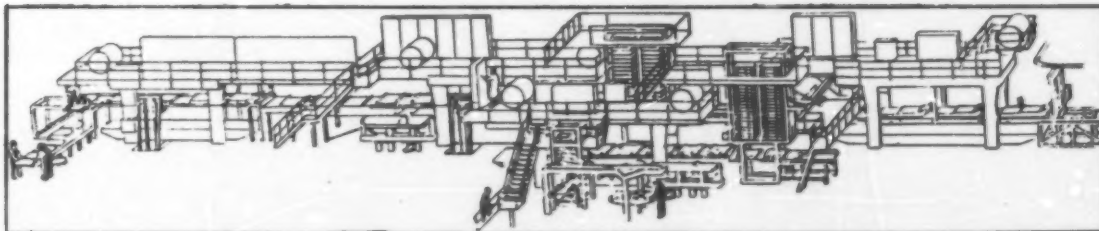
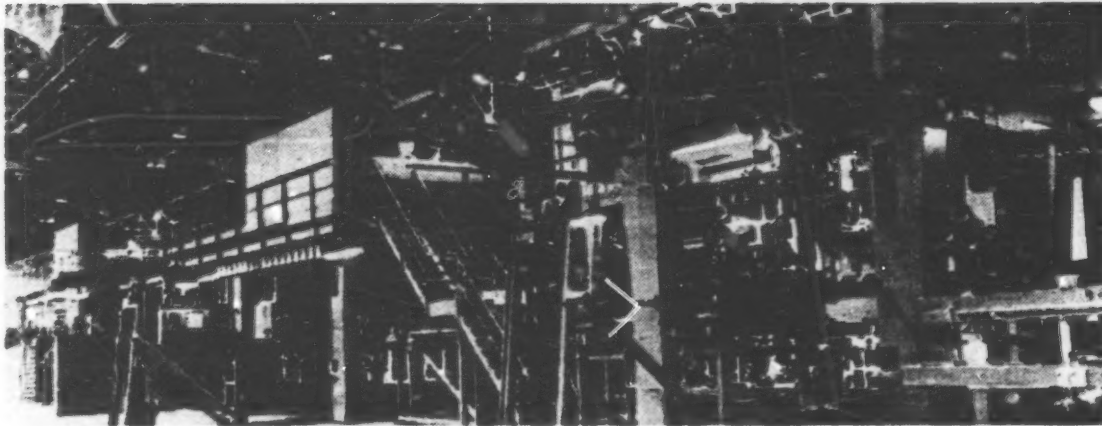
In the measuring room several bodies per shift are tested for accuracy of fit. The 3-D machine can scan up to 124 measuring points. The accuracy of individual assemblies can also be determined on the coordinate measuring machine.



The raw body of the "Mini Metro" consists of 26 prefabricated assemblies. Here the body side is being joined to the floor pan assembly and the rear section.



The "body in white," the "Mini Metro's still unpainted bare metal body is on its way to the corrosion protection and paint plants. Computers make the decisions about the optimal movement of unfinished and painted bodies. The holding area for raw bodies holds 140 cars.



The 58-meter long welding transfer line for passenger car floor pan assemblies during construction at the Longbridge works (top). The perspective drawing of the entire plant shows how, even with extremely short cycle times, high capacity is possible through the use of premanufacturing operations and horizontal and vertical storage containers. Six hundred and twenty two spot welds and 8 projection welds have to be made; cycle time is 42 seconds.

9581
CSO: 3102/335

TRANSPORTATION

PROPANE FUEL FOR AUTOS INCREASES IN POPULARITY

Stockholm SVENSKA DAGBLADET in Swedish 1 Jul 81 p 7

[Article by Anders Hultman]

[Text] "It is now possible to drive with propane fuel from Uppsala to Milan."

This was enthusiastically stated by Esso's project leader for the new fuel, Per Frankenberg.

The expansion that has now begun in Sweden has also begun in France and West Germany. The traditional propane countries of Holland and Denmark already have a well developed network and the Swedish network is beginning to take shape: Esso has propane stations in Uppsala, Stockholm (three stations), Nyköping, Norrköping, Gothenburg, Halmstad, and Malmö.

By the end of the year Esso will have 20 facilities in operation: several in the large cities and one each in Örebro, Jönköping, Västerås, and Helsingborg.

So far Shell has only a test facility in Aspöden in Stockholm. At least 15 propane stations will be built along the main highways and in the larger cities before next year.

"We are working on 20 more to be ready by 1982," Kjell Andersson of Shell said. "By 1985 or 1986 we hope to have 100 stations equipped with gas facilities--if developments are favorable."

Slow Development

So far, however, developments have been slow. The oil companies have been waiting for approved propane-driven cars, while auto makers have been waiting for a developed network of stations.

Now the cars are available. Volvo, Saab, Peugeot, and BMW all presently have "certified" models, i.e., models approved by the Environmental Protection Office. Ford, Opel, Honda, and other Japanese cars are also expected to have propane-driven cars for sale in a short time.

It is estimated that there are already over 200 certified propane-driven cars on Swedish roads today.

"It is expected that there will soon be more. Five to seven percent of all new cars on the market is a realistic trend," Kjell Andersson predicts.

On 1 July another obstacle in the way of propane gas will be lifted: Propane, like gasoline, will be taxed at the source. This means that drivers of propane-driven cars will pay for both tax and propane at the filling stations instead of bothering with the time-consuming tax payments afterward.

2.10 Kronor per Liter

Propane fuel now costs 1.82 kronor per liter. With tax--82 ore--the total price at the pump is 2.10 kronor.

Propane-driven cars use about 20 percent more fuel than conventional cars, to be sure, but the cost per mile is still quite attractive now that gasoline prices are over 3.50 kronor per liter.

The approximately 6,500 kronor extra that propane-driven cars cost compared to a comparable gasoline-driven model must be taken into account, but there are many indications that there are more long-distance drivers than taxis, tow trucks, medical vehicles and newspaper cars that find propane attractive.

Since last year Stockholm's municipal government has bought only automobiles equipped for propane use. Two hundred cars, Fords and Opels, are involved and they will be converted for propane use this fall--and will contribute to even cleaner air in Stockholm.

But even the largest municipality--which has taken the lead in propane use--has been hurt by the slow progress on the part of the Tax and Environmental Protection Offices.

Approved: Self-Service!

One office has made itself more popular among those who want to make Sweden "propane-driven:" the Explosives Bureau, which approved self-service for drivers, who now will not need to wait for service.

It is the goal of the oil companies (more than just Shell and Esso are ready to become involved) to provide the same comforts at propane stations as are now found at gas stations. Eventually there will even be machines operated by credit cards.

Recently one large private company had its own inventory of transport vehicles converted for propane use: Bilja, a large Volvo seller in Stockholm had its Volvo 245's converted to propane-driven 1981 models. Bilja even had the gasoline tanks removed on those cars (a normal propane-driven car retains the gasoline tank, thus doubling the range between fillups). The cars can be driven only in the most environmentally safe manner!

Sweden's first alternative fuel is ready for use.

TRANSPORTATION

AERODYNAMIC LOCOMOTIVES DEVELOPED FOR RAILROAD SYSTEM

Bonn DIE WELT in German 11/12 Jul 81 p 11

[Article by Klaus Mueller: "Upgrading Locomotives"]

[Text] The German Federal Railways [Bundesbahn] are learning from one of the fiercest competitors: Aerodynamicists of the German Research and Testing Institute for Aeronautics and Space Travel (DFVLR) have designed by means of computers and a wind tunnel the shape of a locomotive expected to reach a speed of 350 kilometers per hour in tests at the Rheine-Freren testing grounds. A three-unit train of this type carrying 400 passengers could travel on new and improved tracks at a speed of 300 kilometers per hour.

Of course, as planned, the trains of the Bundesbahn will not travel at speeds of 250 kilometers per hour until about the year 2000. In this respect the FRG lags by about two decades behind Japan, Italy, France and Great Britain, where these travel speeds are already being achieved at least in test runs. As far back as 1931 Kruckenberg's self-propelled railroad car has achieved a world record by attaining a speed of 230 kilometers an hour which it held for 24 years.

At these speeds aerodynamics play a decisive role in the design of the vehicles. Operational requirements such as adequate width for the bogie, headroom and good visibility for the engineer and sufficient room for the electrical equipment must not only be met but also conform to optimal design criteria.

By order of the Ministry of Research the DFVLR Institute for Experimental Flow Mechanics in Goettingen has computed various shapes of self-propelled railroad cars and tested the models in the wind tunnel. The primary objective was to reduce air resistance to a minimum: at a speed of 350 kilometers per hour atmospheric resistance makes up 90 percent of so-called running friction which is the resistance to motion a train travelling at constant speed on a level straight stretch of tracks must overcome. The more running friction--which also includes friction of the wheels on the rails--can be reduced the bigger also the decrease of energy consumption. If running friction of the 2500 locomotives of the 120 series can be reduced by only 3 percent then 75 locomotives will travel practically at no cost, explains Paul-Arnim Mackrodt in the DFVLR NEWS.

Developing low wind-resistance shapes (which incidentally also reduces travel noise) is routine work for an aerodynamicist. Naturally, this is easier to achieve with an airplane: in trains feed arms, buffers, door handles and

insulators disturb the smooth surface creating air eddies at high velocity and raising the noise level.

Excepting some self-propelled vehicles designed a priori for high-velocity travel the Bundesbahn locomotives do not meet the criteria of aerodynamics. Also the new electric locomotives of the 120 series, which are expected to remain in service for some 40 years, are high consumers of power at high speed: measurements taken in wind tunnels disclosed that their air resistance exceeds that of the type 103 special locomotive by 90 percent. Even small changes--a capped roof, disguised buffers and an apron reduced the drag of a train consisting of three coaches by 5 percent.

For the experimental locomotive identified by the logo R/S-VD (wheel-track-experimental and demonstration vehicle), which is expected to undergo tests in 1983, the DFVLR has proposed a head shape resembling that of the type 403 high velocity locomotive. Before building a prototype locomotive wind resistance values will be determined in a German-Dutch wind tunnel on a model scaled down to one-fifth with appropriately designed details such as those of doors, windows or feeder arms.

2886

CSO: 3102/359

TRANSPORTATION

ARTICLE REPORTS ON DEVELOPMENT OF NEW MARINE TURBINES

Stockholm NY TEKNIK in Swedish 29 May 81 p 41

[Article by Ake Bergh]

[Text] A new generation of marine turbines has been developed by Stal-Laval in Finspang.

The system could give new life to steam turbines in large ships. In recent years diesels have been totally dominant.

The system contains a new series of high- and low-pressure turbines and new reduction gears. Together with an English manufacturer, the company is also developing fluidized-bed boilers using alternative fuels. The supership of the future will probably be coal-fired.

Following a decline after the shipping crisis and because rising fuel costs made steam turbines more and more rare at sea, Stal-Laval's marine division is now hoping to make a comeback.

Stal calls its new marine program VAP, or "Very Advanced Propulsion." The program consists of a new series of turbines and reduction gears, but its scope has been increased to include power sources, i.e. steam generators and superheaters.

The latter is a completely new area for the Swedish manufacturer and the company is cooperating with the British firm Babcock-Wilcox to develop boilers.

Stal took the initiative in the joint venture, which has led to the development of fluidized-bed superheaters, which will gradually be followed by complete boiler units using this same technology. The goal is to produce a turbine unit for the future that can operate on fuels that are considerably cheaper than the heavy oil used today, for example, pulverized coal using fluidized-bed combustion.

Development of the VAP has been underway for 5 years and the other day a more or less complete prototype unit was demonstrated at the plant in Finspang.

High-Temperature Technology

The prototype unit, which according to the manufacturer is the most comprehensive of its type in the world, consists of three main sections:

Boiler and superheater
High- and low-pressure turbines
Reduction gears.

The demonstration facility in Finspang has a small, conventional boiler for steam production. The idea, however, is that units used on ships will be provided with fluidized-bed boilers permitting such high temperatures as 600°C that can be fired with low-grade fuel such as waste, peat, heavy residual oil, or what has been considered the most realistic fuel for future ships, pulverized coal in fluidized-bed form, a fuel that can be used with conventional tank arrangements.

Previously, 538°C was the upper temperature limit for superheaters and turbines in steam units. The VAP system used nickel-based alloys in these parts. The technology was taken from the company's production of gas turbines.

Light Turbine Wheels

The turbines use high-temperature technology with steam temperatures of about 600°C. The high- and low-pressure turbines operate at speeds twice as high as Stal's older marine turbines, which means small and light turbine wheels.

The reduction gears are of the planetary type and are very compact. The enormous gear wheel in the final stage of older gears (often 5 meters in diameter) has been eliminated.

Development of the light, new marine gears has led Stal into a new and completely different area of technology, namely windpower. The company presently has orders for five gears of the same type from the American Boeing Company for windpower plants in the United States.

The fact that Stal has entered the area of combustion technology, which is new for the company, does not mean that it will produce steam boilers in the future.

"The reasons we contacted Babcock-Wilcox was that we wanted to accelerate development of more efficient marine boilers," Sven Erik Larsson of Stal-Laval's marine division said.

"New boilers and superheaters are required to develop fuel economy in turbine units for ships."

"The VAP system is also a considerably more complete propulsion system than our earlier units for ships. The system includes new and efficient feed-water pumps and other auxiliary equipment that we manufacture ourselves. Also new is an advanced, computerized control system, which will also contribute to the overall economy of the machinery," Sven Erik Larsson said. According to Stal-Laval the first orders for the VAP system are coming from British shipowners who are planning to replace the propulsion machinery in their older turbine-driven ships.

9336

CSO: 3102/348

TRANSPORTATION

BRIEFS

SHORTS 360: FIRST TEST FLIGHT--London, 9 June--The new Series 360 feeder and commuter airplane of the state-owned aircraft company Short Brothers and Harland in Belfast (Northern Ireland) successfully completed its first test flight in the last few days. The twin turboprop powered aircraft, for up to 36 passengers, took to the air 6 months before the planned deadline, which probably gives it a competitive advantage over comparable new developments from several other countries. Four airline companies have already ordered 11 "360s" or taken out options on it. In the view of Short Brothers, a world market of 1,200 aircraft exists for this type of airplane, of which they hope to take a 30-percent share. A market for the small airplanes, which are intended for short routes with takeoff and landing in the immediate vicinity of cities, has developed principally in the United States. In addition, there should be great interest in developing countries for areas with inadequate overland connections. [Text] [Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 10 Jun 81 p 5] 9581

ROLLS DEVELOPS NEW FAN--Rolls-Royce has been working for about 10 years on a new jet engine fan. The result: The blades are considerably deeper and provide lower fuel consumption (savings compared with the RB 211-535C: about 8 percent) and greater thrust. Plans call for the new fan to be in service beginning in 1984 in the RB 211-535E4. The first aircraft with this power plant will be the Boeing 757. The fan blades are of sandwich construction; a light-metal "honeycomb" is used for the inner structure, the outer skin is titanium-aluminum. Only 23 blades are needed in the new fan, while the -535C required 33. [Text] [Stuttgart FLUG REVUE in German 11 Jun 81 p 11] 9581

FRG-BRAZIL ALCOHOL FUEL RESEARCH--Extracting alcohol from manioc, which is rich in starch, is the object of a German-Brazilian research project. The extraction is to take place at low temperatures using biotechnical catalysts. This new biotechnical method is reported to require less energy than current methods. According to the German research minister, von Bulow, if the project is successful it may be of interest to examine the possibility of using this method in West Germany and other industrialized countries. The Brazilian government hopes that by 1985, 25 percent of the country's automobile fuel needs can be met with the alcohol-based fuel. [Text] [Stockholm NY TEKNIK in Swedish 21 May 81 p 17] 9336

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SCIENCE AND TECHNOLOGY

No. 70



FOREIGN BROADCAST INFORMATION SERVICE

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25 August 1981

WEST EUROPE REPORT
SCIENCE AND TECHNOLOGY

No. 70

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BIOTECHNOLOGY

BRIEFS

ORE-EXTRACTING MICROORGANISMS STUDIED--The West German Research Ministry will invest 3.2 million DM in research to study microorganisms for extracting metals from low-grade ore and mine tailings. The method is used in the United States, Canada, the Soviet Union, and elsewhere. The 3.2 million DM corresponds to about 7 million kronor. [Text] [Stockholm NY TEKNIK in Swedish 11 Jun 81 p 24] 9336

CSO: 3102/354

ENERGY

FIRST FRENCH SOLAR POWER PLANT TO OPERATE AT END OF 1981

Paris AFP SCIENCES in French 4 Jun 81 pp 22-24

[Text] CNESOL-THERMIS, the first French 2.5 MW solar power plant, is to start operating at the end of 1981, according to a document published by EDP [French National Electric Company] on the status of construction work at the Targasonne plant (Pyrenees-Orientales).

Tower solar plants have been under study in France by the CNRS [National Center for Scientific Research] and EDF since 1976. The work has been designated under the code name THEM program (Megawatt Thermo Helio Electric plants). The two organizations made the decision to build the first solar plant in September 1977, but the project was re-directed in the spring of 1979 for budget reasons.

On 20 June 1979, the Council of Ministers decided to set up a thermodynamic solar energy conversion program and restarted the THEM program. A decision was made to implement, along with the Solar Energy Commission which had then just been created, a National Center of Solar Tests (CNESOL), using the THEMIS plant, with a melted salts oven, to study high-temperature cycles. An agreement was signed between COMES [Solar Energy Commission] and EDF in October 1979, designating EDF as the prime contractor for the construction work and for the management of the center until March 1982.

Located a few kilometers from Odeillo and Font-Romeu, the Targasonne site of the CNESOL (at 1,700 m altitude), is one of the sunniest in France (2,400 hours/year).

The Solar Energy Commission, the CNRS, and the research and development branch of EDF all participate in the studies and in the work in progress at the plant under the direction of the Equipment Division of EDF of the Alpes-Marseilles Equipment Region (REAM).

Since the objective of CNESOL is to carry out tests, the site will be equipped with five weather stations, a cloud-detection device, a flux measurement device at the mouth of the oven, an infrared camera inside the oven, etc. It will then be possible to verify the theoretical base which led to the implementation of the plant. Components and technological alternatives will then be tested (THEMIS will be used as a test-bench for the automatic control system which is currently being considered for nuclear power plants). Performance improvements and cost reductions will then be attempted. Finally, there will be a determination of the optimal procedure to run the plant in order to obtain the best possible efficiency.

The CNESOL program is to take place in two steps:

--The first step, which is currently underway, will result in the creation of a double heliostat field, a tower, research facilities, and plant installation. The latter is located near the tower and the air-condenser and includes an area for auxiliary equipment, salt storage and handling, back-up diesel engine, secondary heat storage, melted salt storage, machinery room, electrical equipment room, workshop, and storeroom. Start-up is planned for the end of the year.

--In a second step, which is not in the plans today, it will be possible to add additional loops without interrupting the plant operation by building a second tower and enlarging the plant facility.

Financing and Costs

Financing is being shared at 13 percent by the Pyrenees-Orientales district and the Languedoc-Roussillon region, 39 percent by the Solar Energy Commission, and 48 percent by EDF. On the September 1979 economic basis, the cost was evaluated at 128 million francs not including taxes. This cost included:

20 percent for civil engineering

53 percent for the mechanical area (half of it for the heliostats)

15 percent for the electrical area.

These expenses cover not only construction of the plant itself, but also everything required by the research center, and the difficulty of adapting to the terrain.

Costs

--Total Construction Costs, based on September 1979 costs.....128 million francs

--Basis for the calculation:

--Completion.....9 percent/year

--Rated power.....2,500 KW

--Production at 50 percent
availability.....3 GWh per year (billion KWh)

--Average cost of installed KW

--Construction.....35,000 francs

--All costs included.....36,000 francs

--Cost of produced KWh

--Construction.....2.60 francs

--All included.....2.80 francs

Including operation costs.....5 to 5.40 francs

Features of the THEMIS Solar Power Plant -- 2.5 MW:

Basic life span	20 years
Maximum period of sunshine	1,040 W/m ²
Maximum solar thermal power received	11,170 KWth
Overall gross conversion yield	0.22
Maximum electrical power produced	2,500 KW
Power used by auxiliary equipment	200 KW
Nominal power	2,500 KW
Average annual sunshine	2,400 hours
Solar energy received yearly	18.26 GWhth
Average annual energy yield	0.16
Electrical energy produced yearly	3 GWhe

6445

CSO: 3102/362

ENERGY

GOVERNMENT SUBSIDIZES SOLAR COLLECTORS FOR PRIVATE HOMES

Stockholm NY TEKNIK in Swedish 11 Jun 81 p 11

[Article by Mikael Holmstrom]

[Text] An Italian home owner who wishes to install solar collectors can have the total cost paid by the state and the Italian power authority. The purpose is to reduce electricity consumption--heating tap water by electricity is considered wasteful. Within 6 months, 100 thousand solar collectors will be installed.

Subsidies are now being distributed for solar collectors in southern Italy. The idea is that anyone wishing to heat his tap water using solar heat can go to the local office of the power company. The Italian power authority, Enel, will then give the home owner a list of recommended solar collectors.

Practical Tests

This list is the result of practical tests at a plant in Sicily where the solar collectors were tested. As in Sweden, experience from the first generation of solar collectors was disappointing. However Enel, which has now tested around 80 brands, now believes it will soon be able to present a list of about 25 different solar collectors that fulfill their requirements.

Lower Electricity Bill

Thirty percent of the purchase and installation costs will be paid by the state in the form of deductions and tax cuts. The remaining 70 percent will be returned to the home owner through lower electricity bills.

The background to this generous attitude toward solar collectors is that 72 percent of the Italian electricity production is based on oil. It is estimated that 9 percent of the country's total electricity production goes toward heating tap water.

"Heating tap water is a waste of electricity. It should not be used for showers and cleaning," said Roberto Vigotti of Enel's research and development division.

100,000 Solar Collectors

Enel stated that the goal of the campaign that is now beginning is to install 100 thousand solar collectors in 6 months.

Even though state-owned Enel is not involved in other types of energy than electricity, it is now prepared to enter the heating field. This is being done so that through technical and economic help consumers will use less electricity.

For home heating and for heating tap water in the winter, it is assumed that electric power will be needed in the foreseeable future.

Solar Power Plant

Enel is also responsible for operating the world's first solar power plant for the large-scale production of electricity, recently started in Sicily.

Enel also has certain experiments underway in the field of solar collectors. For remote households it would be economically justifiable even today to install solar collectors instead of constructing power lines. In Italy there are about 1,500 households in this category, but there are no plans in Italy to construct solar collectors on this scale.

9336

CSO: 3102/354

ENERGY

BRIEFS

COAL GASIFICATION PLANT STUDIES--Methanor Company, a subsidiary of the Dutch companies Azko and DSM, and of Norwegian and Swedish partners, is studying the feasibility of a coal gasification plant. The gas produced in this manner could be used to feed a methanol plant with a capacity of 500,000 tons per year. The process used would be the Lurgi process. The gasification plant is to be constructed in Eemshaven, in the north of the Netherlands, and will have a capability of 1 Gcuft/year. [Text] [Paris SEMAINE DE L'ENERGIE in French 25 May 81 p 10] 6445

CSO: 3102/362

INDUSTRIAL TECHNOLOGY

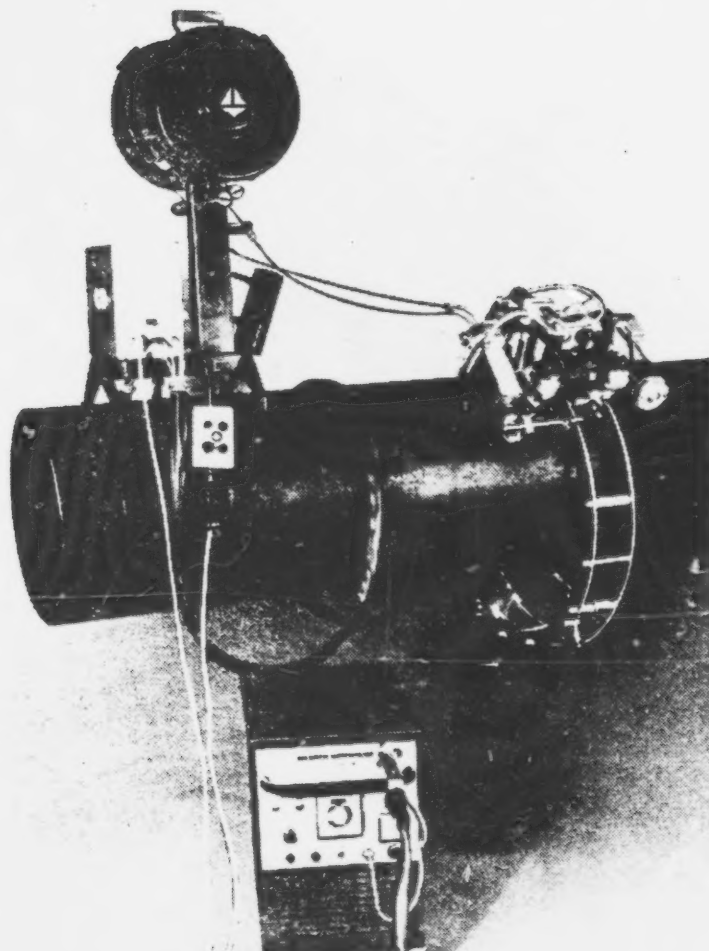
HALOGEN BEAM METHOD USED TO WELD PLASTICS

Duesseldorf VDI NACHRICHTEN in German 29 May 81 p 9

[Text] A process for welding thermoplastic materials such as polyethylene (PE) and polypropylene with halogen light and warm gas has been developed by Messer Greisheim, Frankfurt. The welding material in filament form is fed from a filament supply unit by an electric motor into an electrically-heated and thermostatically-controlled chamber, where it is completely plasticized and converted into a highly viscous strand. At the end of the melting chamber, this strand is extruded through a welding shoe whose shape can be selected for the job at hand and is then pressed into the seam to be welded.

Several supply units are provided for the Varioplast System from which a suitable unit can be selected depending on the application, manual or machine, and on the size of the welding job.

Concerning supply units, a filament feeder and a filament supply are integrated in the unit for manual welding of up to 1 kg/h of polyethylene. All units have an attachment for externally-supplied air for cooling the halogen radiator and for prewarming the material to be welded. In addition, the building-block system also includes equipment for construction-site operation which provides a cooling unit for the halogen radiator and a warm-gas generating unit.



Functional units such as the system depicted here for mechanical orbit welding of plastic pipes can be assembled from Varioplast building blocks from Messer Greisheim

The welding head and halogen radiator for manual welding has a weight of 3 kg. The interior corners of containers can also be welded with special corner jets. Contamination of the welding filament is precluded by the protected-filament feed device. The heating block in the welding head can be changed to permit welding of a variety of materials.

For mechanical circumferential seam welding (orbital welding) of pipes and for longitudinal seam welding, welding-head guides are available for pipe diameters ranging from 90 mm to 1,200 mm and for path lengths from 2,200 to 3,200 mm.

This plastic welding system is suitable for plastic-working shops in the chemical industry and the trades and for the manufacturers of plastic tube and semifinished materials. Opportunities for application present themselves wherever plastic pipes and foils have to be laid, such as in the construction of channels, dams and dikes in the distributed-heat and solar industries.

9160

CSO: 3102/349

INDUSTRIAL TECHNOLOGY

IRON PROCESS USES PEAT INSTEAD OF COKE, SAVES ENERGY

Stockholm NY TEKNIK in Swedish 4 Jun 81 p 4

[Article by Birgit Andersson]

[Text] "Replace old blast furnaces with more energy-efficient methods." This was stated by doctoral candidate Massoud Pirjamali of KTH [Royal Technical University] in Stockholm.

He uses peat as a reducing agent instead of coke. Both gasification and reduction occur in the same reactor.

"We can take away both the coking plant and the sinter plant and by using peat we can utilize our domestic fuel," Massoud Pirjamali explained at the Institute of Chemical Technology. Pirjamali's method is a direct reduction process that yields iron sponge. In this type of process the ore is reduced in solid form. Natural gas or gas from coal can be used. Pirjamali's method is an alternative direct reduction process in which peat is utilized as the reducing agent. The iron is not smelted because the temperature in the reducing reactor is lower than in traditional blast furnace processes.

"Our KTH group has tested charcoal in the laboratory and in a second phase we will now test peat. Our results indicate that we will obtain good reduction," Pirjamali said.

Lower Temperature

The normal blast furnace process at the iron works is used to produce pig iron from enriched iron ore. The process requires a coking plant--the coke is used to reduce the iron ore to iron and keep the temperature sufficiently high. A sinter plant is also required, where the finely ground iron ore, so-called concentrate, is made into small balls.

The temperature in the furnace is so high, around 1,500°C, that the iron ore melts.

All this requires large investments and much energy. The coking and sinter plants together account for almost half the total investments in the blast furnace process.

The sinter plant is responsible for at least 10 percent of the energy costs.

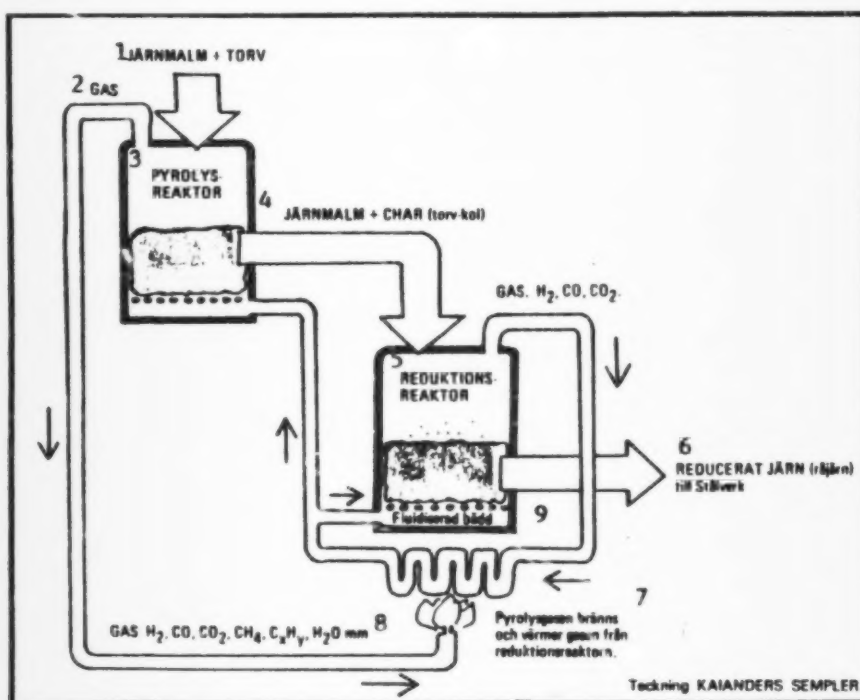
"In our process the iron ore is not melted because the reactor temperature is between 800 and 1,000 degrees.

The KTH method is called iron ore reduction in a fluidized bed and it is accomplished in two stages--first pyrolysis and then reduction.

In both reactors--the pyrolysis reactor can be simply a tube--the solid material floats on gas fed from below.

Ore and peat are fed into a pyrolysis reactor where the iron ore and peat are heated. The pyrolysis process is very rapid. It takes 2 to 3 seconds at 800°C. The peat is then carbonized and forms so-called peat char. Gases are formed at the same time--hydrogen, carbon monoxide, and carbon dioxide. The ore in the reactor, along with the charred peat, proceed to a reduction reactor. The gas from the pyrolysis reactor is burned and heats both reactors.

The char is gasified to carbon monoxide and carbon dioxide in the reduction reactor. The carbon monoxide reduces the ore to iron. The remaining gas recirculates in part to the reduction reactor and in part to the pyrolysis reactor. The product is pig iron which is sent on to a steel mill.



Key:

- | | |
|--------------------------------|---|
| 1. Ore + peat | 6. Reduced iron (pig iron) to steel mill |
| 2. Gas | 7. Pyrolysis gas is burned and heats gas from reduction reactor |
| 3. Pyrolysis reactor | 8. etc. |
| 4. Iron ore + char (peat coal) | 9. Fluidized bed |
| 5. Reduction reactor | |

First pyrolysis, then reduction is performed. Ore and peat are fed into the pyrolysis reactor and heated by gas formed in the process. Peat char, the carbonized peat, is fed into a reduction reactor and there it is reduced to pig iron. Carbon monoxide and carbon dioxide that remain are recirculated, partly to the reduction reactor and partly to the pyrolysis reactor.

9336

CSO: 3102/352

INDUSTRIAL TECHNOLOGY

BRITISH GOVERNMENT FINANCES ROBOTICS DEVELOPMENT

Duesseldorf VDI NACHRICHTEN in German 5 Jun 81 p 40

[Text] The British Government is subsidizing studies relating to possible robot applications up to 50 percent of the associated cost; an initial industrial application or the development of an industrial robot is subsidized up to 25 percent of cost. As British Prime Minister Margaret Thatcher expressed in Brighton in May at the opening of the joint meeting of the European Automated Manufacturing Exhibition and Conference, the International Automation Conference and the British Robot Association (annual meeting), a general increase in productivity and favorable effects on other areas of the British economy are expected from this generous program.

Under these favorable conditions, for example, British Sykes Ltd. is now cooperating with the Japanese company Dainichi Kiko and Hadan Drysys Ltd. with Hitachi. The world's largest industrial robot manufacturer, the American company Unimation, Inc., has already expanded one of its factories in Great Britain because of this generous support. Up to 60 percent of the parts contained in the 20 Puma industrial robots currently produced each month in the Telford factory are manufactured in Great Britain.

That further development of conventional assembly automats should not be neglected while focusing on new industrial robots and sensors is clearly shown by successful Japanese automation measures. A flexible assembly automat from Nippondenso works on 288 variants of indicator instruments for automobile dash-boards. The work-cycle time amounts to 1 s; also, the conversion time from one variant to any other variant takes only 1 s. The assembly machine is converted about 200 times daily while working on average lot sizes of 40 pieces.

What is also clear here is that the success of Japanese industry is not due just to the handling methods used but is also due to consistently designing products which can be produced by automation.

9160

CSO: 3102/349

SCIENCE POLICY

GOVERNMENT'S PORTION OF INDUSTRIAL RESEARCH TO DOUBLE

Paris LE MONDE in French 22 Jul 81 p 11

[Article by X.W.: "Because of Nationalizations: Industrial Research's Share in the Public Sector Will Double"]

[Text] In France as in many other countries, industrial research is completely focused on a certain number of strategic sectors or on advanced technology. The electronics, aeronautics and automobile industries alone accounted for over one half of expenses for industrial research in 1979, which totaled 26.3 billion francs.

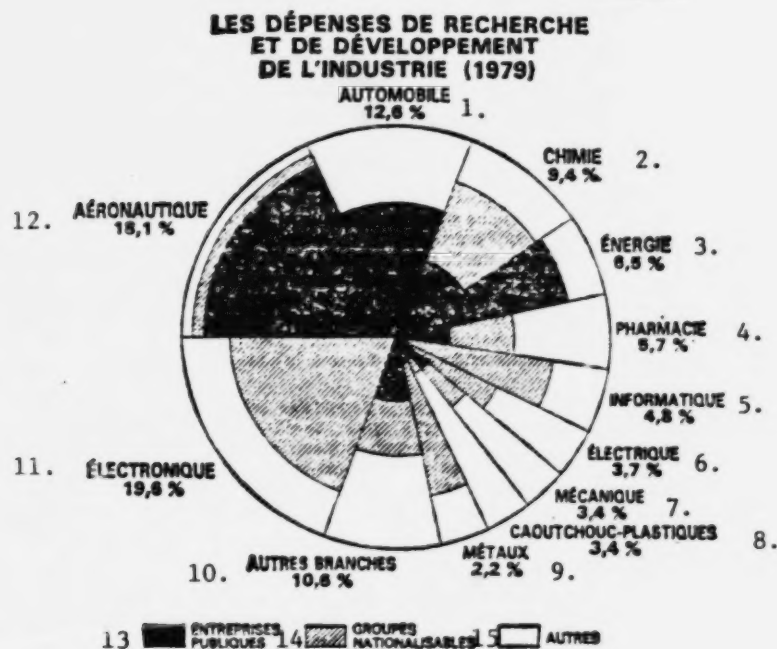
Some of the nationalizations which the government has proposed will affect these strategic sectors. This will, therefore, considerably increase the size of the public and nationalized sector in industrial research. Being in what have been deemed priority sectors, today's "nationalizable" firms (as shown by the well-known "Hannoun Report" on state aid to industry in 1979) are already the prime beneficiaries of public research subsidies.

One effect of the nationalizations will be to practically double the size of industrial research under public control. According to the statistics of the General Delegation for Scientific and Technical Research (D.G.R.S.T.), the current public sector¹ accounts for a little over one quarter (6.87 billion francs in 1979, or 26 percent) of industrial research; nationalizable firms² a little bit more: 7.18 billion, or 27 percent. In 1979, the group "public firms-nationalizable companies" received 82.8 billion francs in subsidies, 3.04 billion (52.5 percent) went to the public sector; 1.76 billion (30.3 percent) went to the private sector which is now nationalizable.

In all, the "new" public industrial sector represents about one third of the national research potential. Taking into account the importance of the public research sector, which is mainly in fields other than industrial research (universities, large institutes), the public sector will control, by the end of the nationalization process, 70 to 75 percent of the total research and development effort in the country.

As the illustration on the following page shows, the state will have under its control 93 percent of research and development in aeronautics (compared to 79

percent today); 60 percent in electronics (0 percent today); 55 percent in data processing (0 percent today); 62 percent in chemistry (15 percent today); and 29 percent in pharmacy (5 percent today).



Expenditures for Industrial Research and Development (1979)

1. Automobiles
2. Chemistry
3. Energy
4. Pharmacy
5. Data processing
6. Electrical
7. Engineering
8. Rubber/Plastic
9. Metals
10. Other
11. Electronics
12. Aeronautics
13. Public Firms
14. Nationalizable companies
15. Other

These figures, which illustrate the impact of nationalization on industrial and technological research, should not, however, be misinterpreted: the state, through the size of its subsidies, already had a certain amount of control on the research of these companies which are today private and will be public tomorrow. (This is obviously the case for defense related research, for example, in the electronics field.) At the same time, firms already in the public sector have almost always kept, until now, a great deal of autonomy in defining their research and development programs.

These data raise a few questions. The state will soon control three quarters of the country's research potential, and over one half of industrial research potential. Will it be necessary to restructure or at least to federate the efforts undertaken by firms dealing at an open international level--and sometimes national level--with the efforts of the major public research institutes such as the Atomic Energy Commissariat or C.N.R.S. [National Center for Scientific Research]? And if so, how?

FOOTNOTES

1. French Electric Company (EDF), French Gas Company (GDF), French National Coal Company, Elf-Aquitaine, SNIAS [National Industrial Aerospace Company], SNECMA [National Aircraft Engine Study and Manufacturing Company], European Propellant Company (SEP), French Company for Aerial Navigation Equipment (SFENA), Renault, National Powder and Explosives Company (S.N.P.E.), Mineral and Chemical Enterprises, S.N.C.F. [French National Railroad Company], R.A.T.P. [Independent Parisian Transport System], Air France, SEITA [Commercial Tobacco and Match Manufacturing Agency].
2. The estimates include the companies--and not just the holdings--and their subsidiaries which are over 50 percent controlled. The list, which contains three companies with heavy foreign participation, is: Thomson, P.U.K. [Pechiney-Ugine-Kuhlmann], C.G.E. [General Electricity Company], Rhone-Poulenc, Saint Gobain-Pont-a-Mousson, C.I.I.-Honeywell-Bull, Dassault, Matra, Roussel-Uclaf, Usinor, Sacilor, I.T.T.-France. For Matra we have included all of the company's research. For I.T.T.-France, only C.G.C.T. [General Telephone Construction Company] was considered.

9720

CSO: 3102/358

TRANSPORTATION

SWEDISH ENGINEERS WORK ON METHANOL-HYDROGEN ENGINE

Stockholm NY TEKNIK in Swedish 4 Jun 81 p 19

[Article by Ulf Bergmark]

[Text] Fuel consumption by automobiles can be cut in half. This is the contention of Krister Sjostrom, researcher at the Technical University in Stockholm. He is leading a project on energy-efficient engines driven by methanol and hydrogen. This research is now facing a breakthrough, both in Sweden and the United States.

In the United States, where this research has proceeded further, an automobile engine has already been constructed that proves Krister Sjostrom is correct: energy consumption can be drastically reduced in an automobile engine.

This requires that the engine be run on methanol instead of gasoline.

At the university's Institute for Chemical Technology the methanol engine has been run since 1977. The present engine is a Volvo B 20 equipped with a nickel catalyst that converts part of the methanol to hydrogen and carbon monoxide ($\text{CH}_3 \rightarrow \text{CO} + 2\text{H}_2$).

Water and Carbon Dioxide

Under partial load the engine operates on gas alone. Hydrogen is an ideal fuel that forms no exhaust gases that are harmful to the environment when burned, only water and carbon dioxide.

Since the hydrogen can be produced in the car, no heavy, bulky pressurized containers or metal hydride tanks are needed. The energy storage capacity of methanol is 20 MJ/kg. The corresponding figure for magnesium hydride is a maximum of 6.8 MJ/kg. In a pressurized vessel the storage capacity is even lower.

The remarkable thing is that the gas (hydrogen + carbon monoxide) has a 10 to 20 percent higher energy content than the methanol. The explanation is that part of the heat energy in the exhaust gases that run the catalyst are converted to chemical energy.

Krister Sjostrom and his colleagues Soren Eriksson and Gunnar Landqvist have produced a proposal for an optimum engine. The present engine must be improved in three respects.

Higher compression. In a methanol-hydrogen engine the compression ratio can increase to 14:1. This increases efficiency by 10 to 15 percent over a normal gasoline engine.

Greater air excess. Hydrogen is an economic fuel because it requires very small quantities of gas to make the fuel-air mixture burn.

While gasoline does not ignite in an engine with just a 10 percent air excess, hydrogen can burn with an air excess of 500 percent in fuel-air mixture. The optimum air excess is 300 to 400 percent.

Doubled Efficiency

Thus, a hydrogen engine can be driven with wide-open throttle even at low loads. This means doubled efficiency under partial loads, i.e. during normal driving. An open throttle creates a high vacuum in the intake manifold. This vacuum, which can be half of atmospheric pressure, "brakes" the piston as it drops during the intake stroke.

The disadvantage with the lean fuel-air mixture is that the peak performance is low. When the gas pedal is depressed, therefore, methanol is injected along with the hydrogen. When the engine is under full load the motor runs on methanol alone.

The catalyst may be changed. For the nickel catalyst to function, part of the gases must recirculate. Otherwise, carbon may be deposited as a layer of soot. This decreases the excess energy in the gas to 10 percent over the methanol. With a copper-zinc or a noble metal catalyst the energy surplus is 20 percent.

The research grant from the Board for Technical Development will run out in October. If more money is forthcoming, a first Swedish car with a methanol-hydrogen engine will be produced in about 3 years. So far, many questions remain unsolved, for example how the control system will be made and what type of catalyst will be used.

No More Expensive

It is still too early to say how much such an engine will cost in series production. It will hardly be more expensive than a diesel engine, however, but much more energy-efficient.

According to our estimates this engine could be so energy-efficient that it would pay even to convert gasoline to methanol, Krister Sjostrom said.

In the United States, a Chevrolet Citation is being run with a methanol-hydrogen engine. It uses a copper-zinc catalyst. The compression ratio has been increased to 14:1. A propane carburetor used in ordinary gas-driven cars feeds in the gas and an injection system feeds the methanol.

The car was built by the Energy Department's solar research laboratory, Serl in Ohio in cooperation with the Jet Propulsion Laboratory in California.

A preliminary report on the American experiment will soon be published. The research leader at Serl, Joe Pinegold, has stated that this engine can be twice as efficient as a gasoline engine.

Research on methanol as a hydrogen carrier is also being conducted at several American universities. Soviet researchers are also reported to be experimenting with methanol-hydrogen engines. The Soviet Union has a relatively extensive research program on hydrogen-driven cars.

93336

CSO: 3102/352

TRANSPORTATION

EUROPE'S CAR PRODUCERS' FIGHT FOR SURVIVAL

Hamburg DER SPIEGEL in German 8 Jun 81 pp 36-48

[Unattributed article: "The Fight for Survival — European Auto Manufacturers Investing Billions"]

[Text] The major auto manufacturers in Europe and the United States are planning to invest billions to save their industry from its most serious crisis to date. Nevertheless, pressure from Japanese competitors and future surplus capacities could very soon mean the end for many a European make of automobile.

The construction workers first carted away 700,000 square meters of marshy North German soil and then poured in a million cubic meters of dry sand. Thousands of iron rods have already been anchored in the ground, and tons of cement are now disappearing into the excavations every hour.

Even from a distance, a forest of giant construction cranes next to Sebaldsbrueck's Heerstrasse in the northern part of Bremen announces the presence of the largest construction site in the Federal Republic. And there, where to the right of Heerstrasse sit the small suburban homes numbered from 236 to 307a, a huge sign rises high out of the ground on the left.

It shows a neat model of the new factory, with much greenery and few smokestacks. The builder-owner is advertised in small letters: Daimler-Benz AG [Co, Inc].

In Bremen's Sebaldsbrueck district the Stuttgarters are now investing the enormous sum of far more than DM 1 billion to construct new assembly buildings. Up to 120,000 cars are to roll off the assembly line here every year beginning in 1983.

Just like Mercedes in Bremen, and just as though the golden age of the automobile still lay ahead, Volkswagen and BMW, Ford and Opel, France's Renault and the European branches of General Motors are also investing billions in new factories and new machinery, in designs for new bodies and new engines. Says VW chief Toni Schmuecker: "We have to invest, invest, invest."

The auto executives have been topping one another in recent months with their announcements of new programs costing billions: Mercedes plans to invest DM 10 billion in 5 years; Volkswagen is doing 13 billion in 3 years; Fiat has announced 11.5 billion, Ford 10 billion and BMW the sum of 4 billion.

What for? For even more cars on roads that are already overcrowded? For an even higher oil bill? For even more din and stench in the cities?

Not for any of this, say the auto executives, while promising the opposite: the car that can do everything better.

Nonetheless, all the billions in investments and all the promises do not change the fact that the shine has worn off the chrome, paint and horsepower, that the industry is approaching the limits of its growth.

The star industry from the years of the economic miracle has yet to digest the oil price shock of 1974-80 — and it will not be the last one. It must deal with a still growing distaste for a consumer culture whose undisputed symbol for more than three decades has been the automobile.

The markets are nearly saturated — at least those in Western Europe and North America — and wherever there is anything left overseas, the Asians are cleaning up: Toyota, Nissan, Honda and company — the ones who have risen from nearly total obscurity to become the world's number one automobile power.

Initial shock waves reached the industry long ago: In England, British Leyland is being kept alive only with difficulty, with billions from the tax coffers; in the United States, the country's largest automobile company, Chrysler, would be finished without money from Washington; in Italy, Alfa Romeo has been supported by the state for years.

France's giant of the auto industry, the PSA group consisting of Peugeot, Citroen and Talbot, is reporting mass layoffs, plant closings and a flood of red figures. Italy's Fiat is fighting for survival at the same time: A series of unending strikes and a worn model strategy have been pushing the once strong automobile company to the brink.

In the United States, "by far the worst year the industry has ever had" (according to Road and Track, the car magazine) affected all the producers: General Motors, Ford, American Motors and Chrysler together came up with the astronomical sum of a good \$9 billion in losses for 1980 alone.

In the FRG as well, where car companies experienced a boom from 1975 to 1979, the auto festival has been winding down rapidly. Since that time there have been mass layoffs once again — 6,000 workers at Ford and 6,000 at Opel — short hours, red figures and signs of crisis — even at Volkswagen.

There is no longer any hint that the good old days for the automobile will ever return. Only a few optimists expect more cars on Europe's roads. More skeptical professionals in the industry — like VW's man in charge of sales, Werner P. Schmidt — know that "there won't be any further growth worth mentioning" in Europe.

Those who know the market estimate that annual growth will amount to between 1 and 2 percent at the most up to 1990 — over the next 10 years, in other words. The auto executives have reason for nostalgic daydreams: Between 1960 and 1980, output doubled in the West European auto industry, from a level of 5.5 million to more than 10 million vehicles.

Marketing Systems, the Essen auto forecasting institute, is prophesying another unpleasant trend for the Europeans: The industry's exports will be declining steadily — from the present level of 50 percent of total production to only 45.7 percent by 1990.

The Europeans' proud export percentage is being depressed by increasing Japanese sales and by the increasing presence in export markets of manufacturing operations performed abroad by European auto companies.

More than untimely in this situation is the worldwide onslaught by the Japanese, who have meanwhile become the world champion auto producers in terms of numbers.

Last year alone, more than 1.6 million Japanese cars rolled onto the U.S. market. The nimble Asians shipped an additional 1.3 million vehicles to Europe. The competitors from the Far East gained a 10.4-percent share of the FRG market — with 252,000 cars — thus moving ahead of the French and the Italians as the most successful importers.

The disastrous combination of growing Japanese competition, stagnating domestic markets and rising gasoline costs constitutes a threat to the established European automobile producers unlike any ever experienced by the industry. The change could mean the end for many a proud name in automobiles.

The forecasters at Renault, France's state-owned company, expect that there will be only six mass producers of cars left in the free world by the end of this century: including two Japanese — Toyota and Nissan; two American — General Motors and Ford; and two European — Volkswagen and Renault.

As the argument goes, only these six auto manufacturers possess the necessary financial resources, have balanced model programs and have rationalized their production operations to the point where they are already equipped for the battle over the markets of the future.

The managers of smaller automobile concerns — BMW chief Eberhard von Kuenheim, for instance — are not at all happy to hear such prognoses. Von Kuenheim has this comment: "One says that 5 will be left, while another guesses 8 or 10, but BMW will also still be around 20 years from now."

To safeguard his chances, von Kuenheim now has to do precisely what all the other major auto manufacturers are doing: He is investing record amounts in new plants, highly automated production processes and new, fuel-efficient models.

Outlays for these things appear just as sensible to von Kuenheim as they do to VW chief Toni Schmuecker and Ford boss Philip Caldwell. But does the investment craze make sense for the entire industry as well?

Hardly. If all the manufacturers do the same thing — as is happening right now — the competition will only become stiffer in stagnating markets. If everyone thinks he is on the right track with an expanded program and surplus production, then no one will have any advantage in the end. Survival will then be even more difficult for all.

One good thing about the billions now being thrown around in such anticipation of the future is that some of the investors will be forced out of the running all the sooner. So the investments will act to speed up the weeding-out process.

The auto executives maintain that they have no other choice. Since the Japanese appeared on the scene, no other word has gotten such a workout in the auto companies' executive high-rises as the word automation. But Europe's automobile plants can be further automated only if billions are spent to convert the old factories or to build completely new ones.

Operating alongside this is a second program costing billions. The extreme rise in the cost of gasoline has had such a lasting shock effect on Europe's drivers that they no longer value so highly their previously so popular middle-range cars -- like the Renault 20 or Audi 100, the Opel Rekord or Fiat 131. In some instances, sales for this type of car have dropped by 50 percent.

It is the upstanding family man, the better-positioned white collar employee or the well-paid worker who is suddenly having to acknowledge that his car has simply become too expensive. Such people used to move up to at least a somewhat bigger car every time they bought a new one. Now, one by one, they are dropping down to smaller cars and diesels.

More and more frequently, one sees drivers acting as rationally as the Hamburg ship-owner who converted his entire motor pool to economy cars. He now has himself chauffeured around in a diesel Rabbit.

The manufacturers are logically rushing to develop new car models that can run on less gas. And just as logically, the competition is becoming stiffer; additional surplus capacities are piling up.

Everyone is participating in the cutthroat competition. At BMW, for instance, Eberhard von Kuenheim is just now putting a new, small engine (1.5-liter piston displacement) in his Series-3 models. Moreover, he is considering building an even smaller car at a whole new plant.

Furthermore, the plant in Dingolfing is being expanded by means of an enormous investment -- from a daily capacity of 650 cars to 1,000 in the future. BMW is also building a new diesel engine plant in Austria and starting a rationalization program: The Munich firm plans to have about 300 robots operating by 1985.

All the expenditures are essentially quite correct: Increased capacity and automation can bring more business and greater profits; smaller cars belong to the future; and a diesel is necessary because it also makes big limousines economical.

The only problem is that the competition is doing the same thing. In Stuttgart, for example: Mercedes has had a diesel for a long time; and the Swabians will be bringing out their smaller car in 1982, when von Kuenheim finally comes out with his diesel.

Daimler-Benz is not sparing the cost on its small car: More than DM 1 billion is going into the new plant in Bremen, which is scheduled to produce close to 120,000

cars per year initially, with as many as 240,000 per year during the second phase of construction.

The Stuttgarters are simultaneously spending millions to modernize their plants in Sindelfingen and Unterturkheim. In 1985, Mercedes plans to put together up to 560,000 cars in these new buildings and the remaining old ones. That would be twice as many as in 1970.

And Toni Schmuecker will not be willing to stand by and do nothing. It is true that he is not lacking in small cars, and he already has his diesel, but at the top of the line, where Mercedes starts, Schmuecker still considers himself weak. For that reason, the new Dasher has now been made longer, heavier and stronger — using the five-cylinder Audi engine.

This is also why the Santana is scheduled to appear in showrooms in the fall. The car is bigger than the Dasher and will presumably also be the first six-cylinder Volkswagen on the market. Once the Santana comes out, then the new Audi 100 must in turn be made larger and more up-to-date.

And the merry-go-round keeps turning: Ford and Opel have of course also initiated programs costing billions. After all, the U.S. offshoots of the international General Motors and Ford companies want to keep growing in Europe, at the expense of others if it has to be that way — and it probably does.

Ford first advanced into the small car class of the VW Polo, the Fiat 127 and the R 4 with its Fiesta. At that time the Cologne automakers built a brand new plant for the first mini-Ford in Saarlouis. The factory has recently been cleared to make way for the new Escort. Fiesta production was moved to Spain, where an even newer plant has been raised in the meantime.

The capacity of the Ford plant near Valencia — now at 260,000 Fiestas per year — is being expanded even further. In addition, another production facility for the Escort is to be built in Spain — all are new capacities for an already saturated market.

Ford's Fiesta is giving Opel no respite. Not exactly on good advice, the Ruesselsheim company had first sought to make inroads in the BMW and Mercedes class with its large models, the Senator and the Monza. Success was only temporary.

Opel's engineers are now working feverishly on a new mini. It will perhaps be rolling into the showrooms by late fall, adding to the competition among the small cars.

General Motors (GM), Opel's parent corporation, is not afraid of the crunch. GM is carrying on the most ambitious expansion program of all the Europeans: The new factory buildings being put up by General Motors are already giving the competition the shakes.

Just as though Europe were still an underdeveloped continent with a large and unsatisfied demand for motorized transportation, in June 1979 GM's management in Detroit decided on an aggressive strategy for the Old World.

At that time Elliot M. Estes, then head of GM and now retired, made known his displeasure that Ford was selling more cars than his own company outside the United

States, especially in Europe. "We're certainly not proud of that," said Estes. "We're after Ford, and we're going to catch Ford."

General Motors is consequently now building half a dozen new plants in Europe alone and is expanding existing facilities in the FRG and in Luxembourg, Belgium and England.

Construction of the new factories in Spain, France, Austria, Greece and Northern Ireland is costing nearly DM 5 billion. Those who know the industry predict that GM will be increasing its European production capacities not only by 300,000 vehicles annually, as was announced, but actually by 500,000.

It is more than uncertain whether there will be buyers for them, but GM's thinking is not so complicated as that — the company simply wants to shoot down its rival, Ford.

Also drilled in the expansion discipline are auto manufacturers in France and Italy as well as Ford in England. In France it is mainly Renault, while the second PSA group (Peugeot, Citroen, Talbot/Simca) is already having trouble keeping its accounts balanced. For 1980 alone, PSA has had to write off around DM 800 million in losses.

"What's going on at Renault is really something," says VW chief Schmuecker. Like Volkswagen, the French have converted their model program to a cost-effective system of assembling prefabricated parts. They plan to increase their production from a scant 2 million vehicles to 2.5 million by 1985.

In addition, Renault chief Bernard Vernier-Palliez has signed on with American Motors, is cooperating with Volvo and has gotten into the truck business in a big way: Renault has purchased 20 percent of Mack Trucks (United States) and is now taking over truck production from PSA.

Italy's Fiat needs no new plants. Just a return to normalcy would be enough to increase the Italian automaker's production by about 300,000 units per year. Wage strikes, political work stoppages and chaotic disturbances have constantly disrupted production in recent years.

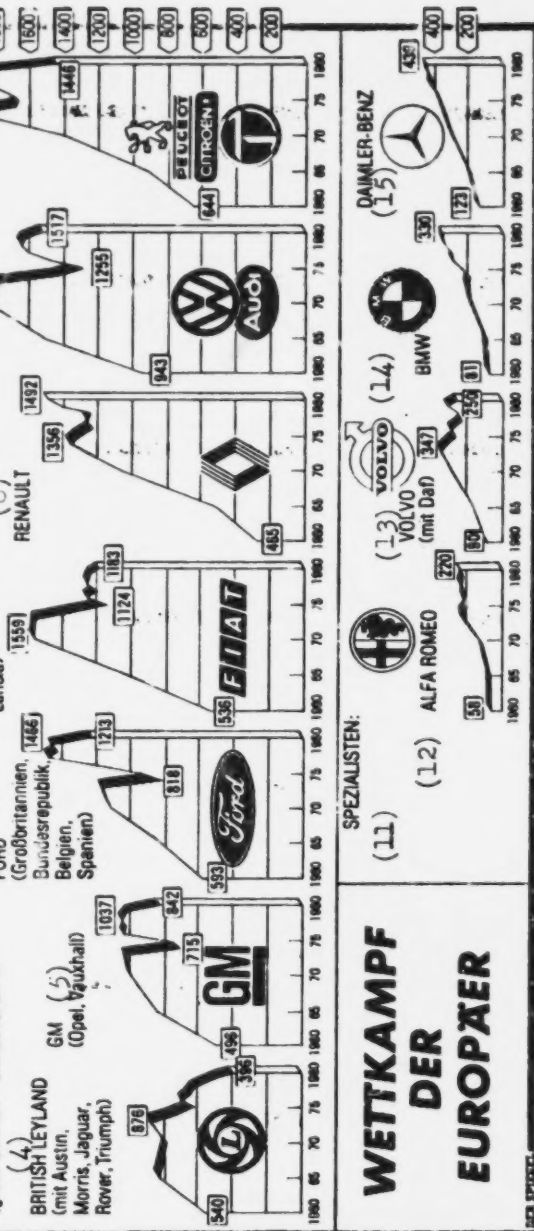
The situation has meanwhile grown more peaceful in Turin. And at least Fiat President Giovanni Agnelli is sure that his corporation is again being counted among the aggressors in the fight for Europe's drivers.

But at the moment he is more likely to have to go on the defensive — above all against the Japanese, who continue to be fully geared to the attack.

To be sure, the Far Eastern car manufacturers are cautiously in the process of changing their strategy. They know that they will not be able to do much more in Europe with exported cars alone, for that would only intensify the protectionism already being practiced extensively against Japanese cars. The Asians are consequently planning to increase their production and assembly operations in Europe.

(2) Pkw-Produktion der großen Autofabriken in Europa: in tausend Stück

In den vergangenen Jahren sind etliche Einzel-
firmen in Konzerne aufgegangen. Zum besseren
Vergleich sind die Produktionszahlen auch aus
der Zeit vor der Zusammenlegung addiert worden.
(graue Streifen = Ölkrise 1973/74)



Key:

1. Competition Among the Europeans
2. Passenger vehicle production by Europe's large auto plants; in thousands
3. A few private companies have merged with corporations in recent years. To provide a better comparison, production figures for the time prior to the mergers have been included. (heavy gray lines = oil crisis, 1973-74)
4. British Leyland
5. GM
6. (including Austin, Morris, Jaguar, Rover, Triumph)
7. (Opel, Vauxhall)
8. Ford
9. (Great Britain, FRG, Belgium, Spain)
10. PSA
11. (Peugeot, Citroën, Talbot/Simca/Chrysler, Matra)
12. Specialists:
13. Alfa Romeo
14. Volvo
15. (Including Daf)
16. Renault
17. VW/Audi/NSU

Leading the pack in this regard is Nissan (Datsun), the second-largest Japanese company. Nissan President Takashi Ishihara allied himself with Italy's Alfa Romeo, went in with Motor Iberica in Spain and is planning his own branch plant in England costing DM 1.4 billion.

At all three locations, Ishihara will see to it that in the end at least 200,000 cars are rolling out of the plants each year. This is the minimum volume for a highly automated production operation.

Japan's largest producer, Toyota, is still looking around in France and England for the best possible piece of land and for maximum subsidies — which the Japanese, just like their European competitors, collect as a matter of course as a reward for creating new jobs.

Honda has already allied itself with British Leyland. The Japanese and the British plan to join forces to design and produce an automobile.

The sons of Nippon in Europe will be constructing the most modern of the modern items offered by automobile company outfitters. And they will be settling in areas where wage costs are far lower than they are in places like Wolfsburg. Moreover, it might prove less expensive to fly individual parts from Japan across the high seas to Europe than to take the trouble to transport completed cars in special ships.

Then Japan's auto companies will be using the export cars they no longer market in Europe to press the Europeans even harder than before on the export markets in Asia, Africa and South America. In these more or less developed countries where the demand is chiefly for robust, simply constructed and low-cost cars, the Japanese are in a better position than their European competitors, with their relatively expensive and technically exacting models.

There is only one way for the Europeans to escape this pinch: They, too, will have to produce vehicles in faraway markets, cars that are adapted to the needs of the area. VW is trying this in Mexico and Brazil, for example.

But this will only worsen sales prospects for cars coming out of Europe. In extreme cases, the situation will be the same as with VW and Fiat: Volkswagen is now importing the VW Bug from Mexico, and Fiat is supplying the domestic market with mini-diesels from Brazil.

VW has come up with new capacities for the European market in recent years without building a single new plant — they were found in the domestic plants that used to produce for export.

The trend is even intensifying: VW is now building a second plant in the United States, for approximately another 200,000 cars per year. The cars built at the Linden factory — which used to produce exclusively for export to the United States — will then have to be sold in Europe.

And another serious situation is that not only is it becoming increasingly more difficult for many a European auto company to export to the United States, but the Americans themselves will soon be launching an export offensive aimed at Europe.

Although the U.S. auto industry is presently struggling through the most serious crisis in its history, the way in which it is carrying on the fight is worthy of note: By 1985, the industry will have invested around DM 160 billion in new cars and new manufacturing installations in its own country. The billions which all the Europeans together are planning to spend in the years ahead appear modest by comparison.

The Americans could jeopardize above all the manufacturers of products in the middle range — companies like Volkswagen and Renault, Fiat and PSA. For the first time in the history of automaking, General Motors and Ford will be building cars capable of challenging any European car — cars like the new Ford Escort, designed for small fuel-economy engines and highly automated production.

If the Americans achieve their goals, then even more pressure will be placed on the Europeans, with their production figures amounting to a maximum of 3 million cars per company. The Europeans will hardly be able to undercut the prices calculated for the U.S. companies with their enormous export volumes.

BMW chief von Kuenheim understandably sees things differently: "The giants of the industry are the ones having the greatest difficulty today," he says, "not a company like BMW." The man from BMW fancies every advantage for the "relatively small, non-bureaucratically managed" auto company in the future as well. He says it is these very firms that are more flexible and closer to the market. Furthermore, they could easily realize for themselves the advantages of large-scale production through cooperation agreements.

But VW chief Toni Schmuecker has greater respect for size: "When the Americans tackle something, they go right at it in a big way." And Mercedes executive Helmut Schmidt is pessimistic: "The Americans are the Japanese of tomorrow."

That can even be taken somewhat literally: Ford has an interest in one of Japan's largest manufacturers, Toyo Kogyo (Mazda), and is also planning to join forces with Toyota in the United States to build a plant for 300,000 cars per year. General Motors executives have also already put out feelers to Japan. GM has an interest in Isuzu, a still small manufacturer which is now expanding its plants with money from GM.

By the time the Americans and Japanese have established close production ties, even the European producers that still number among the really strong could go into a tailspin: Volkswagen and Renault.

The others, the ones who have already been hurt — like British Leyland, PSA and Fiat — would then disappear from the market as independent companies.

Only the automobile world's specialists in image and quality would perhaps remain untouched — provided that the top managements of companies like Rolls-Royce or Porsche, but also Mercedes and BMW, made no mistakes — in their models policies, for example.

BMW chief Eberhard von Kuenheim has to be especially careful. Though BMW has hitherto fared well under his direction, the Munich car makers are by no means as flush financially as a company like Mercedes.

The Munich firm also falls short when it comes to the scope of its program and the international sharing of risks. With nothing in hand but the advantage that a small company can operate much more flexibly in the marketplace, things will become increasingly tougher for von Kuenheim.

On the other hand, Mercedes chief Gerhard Prinz is basing more than 50 percent of his production on trucks and is working quite vigorously to make his corporation the leader in this segment of the international market.

Prinz has now established his company on the U.S. market as well, with his purchase of the Euclid company, a U.S. manufacturer of earth-moving machines and other extremely heavy vehicles used in mining and roadbuilding; he has also acquired Freightliner, a manufacturer of heavy trucks.

Prinz's competitors share his view that the future looks more profitable in North America and in the utility vehicle sector than it does in the hotly contested European passenger car trade. However, the others lack the millions and the know-how needed to do what he is doing.

As usual, Mercedes is in a better position than its competitors are — also in the private car business. While in recent months large numbers of wealthy clientele of Opel and Ford, BMW and Audi, have stopped buying their relatively expensive mid-range cars, Mercedes buyers have shown themselves to be virtually unconcerned.

The reason is that a Mercedes driver, whose car is financed by his company or his practice if need be, is a stranger to the financial pinch felt these days by the driver of a Granada when he puts his gas pedal to the floor.

To be sure, those who are making a switch are not at all unwelcome to the industry. Since the beginning of the year, since everyone realized that the price of gasoline is moving steadily toward DM 1.50 [per liter], there have been slightly happier faces at Volkswagen, Ford and Opel.

"We're experiencing a minor boom," says VW's head salesman Schmidt, happily. "We're even sold out for months ahead on the small diesel cars."

If the costly trend in oil and gasoline continues unbroken for a long period, it could at least make the industry the beneficiary of a new urge to purchase on the part of drivers who simply no longer want to buy the gas for their old gas guzzlers.

It is of course highly questionable whether this will be enough to keep in operation all the new assembly lines and automatic welding machines that are now being installed from Valencia to Wolfsburg. For in the long run, there is not much business to be had from drivers who want to save their money.

The car salesmen in the executive suites have suspected for some time that there is danger not only from the Japanese and the Americans, from increased gas prices and the oil shortages.

For, once the automobile loses its image as a prestige product, once it is purchased and treated like a cooking pot, the situation will really begin to get tight — as tight as it was after the first oil shock in 1973, when only 1.6 million cars were

sold in a 12-month period in the FRG, as opposed to the year before when a good 2 million were sold.

We have apparently gotten over that shock; it was followed by the biggest boom in the history of European automaking. Nonetheless, to the distress of the industry the creeping devaluation of the private automobile as an object of fun and prestige appears to be relentless.

Particularly depressing to the marketing experts has been the effortless march of the Japanese cars, their immediate acceptance as low-cost alternatives to the renowned European makes. The experts can no longer count on blind loyalty to makes of cars even at home.

It is for this reason that the billions now being invested so feverishly in the future of European cars are to some degree also a sign of uncertainty. None of the auto executives really knows what is going to happen. But no one wants to leave himself open to the charge by his board of directors in 5 or 8 years that he missed the boat in the early 1980's. After all, the money now being spent on all the new plants and equipment was accumulated during the last automobile boom. Now it has to be spent.

So now, with sums unparalleled in history, they are all mobilizing for the fight for survival — and possibly mobilizing each other right out of existence.

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TRANSPORTATION

COMMENTS ON JAPAN'S AUTOMOBILE INDUSTRY

Hamburg DER SPIEGEL in German 8 Jun 81 pp 48-59

[Article by Ford executive Robert Lutz: "With Our Backs to the Wall"]

[Text] Over the past 25 years, we have seen how the Japanese have been securing for themselves a position of worldwide supremacy in traditional Western branches of production: the usual things like the camera, timepiece, hi-fi, recreational electronics, calculator or motorcycle industries — to name the most important ones.

In each of these instances, the increasing onslaught of Japanese imports has been the cause of serious inroads and has led to the virtual disappearance of the comparable branch of Western industry.

This resulted in a drastic decline for companies and employees in these economic sectors. Affluent Western economies blessed with growth were able to absorb the losses of these jobs initially, for employment figures in the affected industries were more likely to be in the thousands than the hundreds of thousands or millions. Moreover, manpower was in demand everywhere.

But all of a sudden we now have our backs to the wall and are fighting for the survival of the Western automobile industry.

If this view seems too extreme for anyone, I should like to substantiate it with a few facts:

In 1980, Japan became the world's largest automobile producer — with production amounting to more than 11 million cars and trucks — surpassing the traditional number one producer, the United States, by 3.1 million units, or by 40 percent. Markets such as the Far East or Africa are now almost exclusively in the hands of the Japanese. The same thing is happening to a growing number of European markets where there are no restrictions of any kind on imports from the Far East.

In Germany, the Japanese share of the private automobile market grew from 5.6 percent in 1979 to 10.4 percent in 1980. Despite a distinct drop in customer deliveries during the second half of 1980 in Great Britain, the Japanese achieved a level of about 12 percent, thus breaking their promise to limit their share of the market to 11 percent.

Their market shares have risen spectacularly in Holland, Belgium, Finland, Switzerland, Denmark, Norway and Austria — countries which have been granting the Japanese free access, unrestricted in terms of volume. Most of the European automobile producers are able to maintain their presence on these markets only by being willing to live with declining sales or with losses per unit sold, or both — because of the price situation which favors the Japanese.

Now that opportunities for export to Third World countries have virtually been eliminated, now that the "unprotected" European markets are being lost at an increasing rate, now that the Japanese are getting larger shares of the U.S. import market than the European manufacturers, and now that the attack on the German market — as one of Europe's most important historically and most interesting in terms of trade — has been prepared most carefully and has now begun, can the Western automobile industry survive for long?

Can this industry demonstrate endurance when most companies in this branch are showing either substantially reduced profits or even losses? Will the same thing happen to the automobile companies as happened to the manufacturers of cameras, watches and motorcycles? And should this be allowed to happen?

As I see the situation, the loss of the car and truck industry would be tantamount to a de-industrialization of the Western world. For it is not thousands, but hundreds of thousands and — if the subcontractor industry is included — millions of jobs that are at stake here.

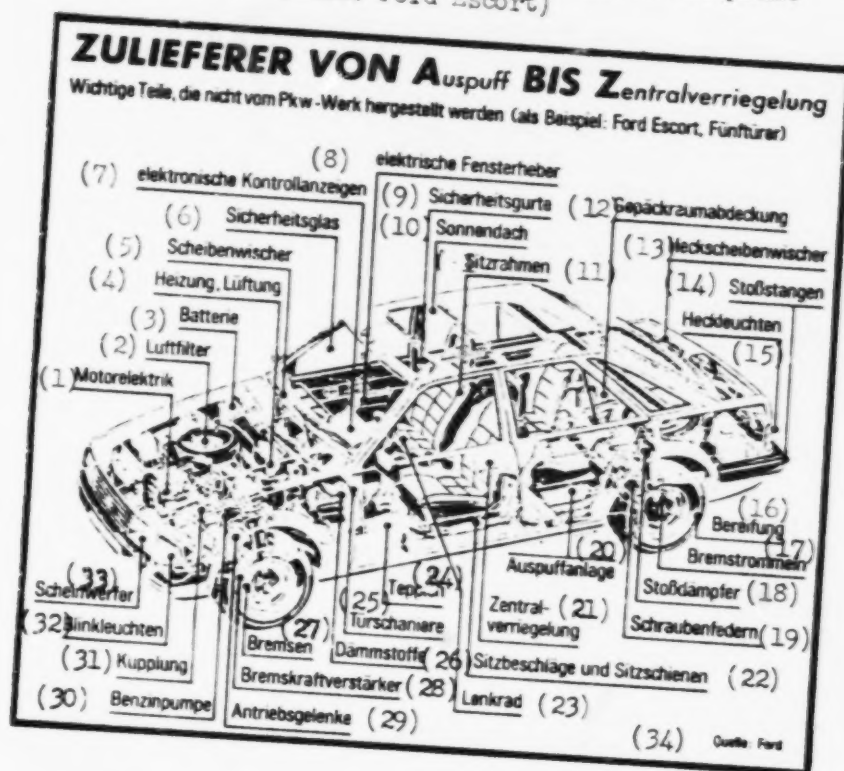
Indeed, the West would be losing not just the work that goes into the final assembly of every single imported Japanese car. The steel, glass, rubber, plastic and paint used in Japanese cars does not come from Europe or America. The cars do not use Michelin or Continental tires, Fichtel & Sachs shock absorbers, Champion spark plugs, Hella light bulbs or other products manufactured by thousands of large, medium-size and small companies that back up the automobile industry as suppliers of subcontractor products — in the Old World as well as the New.

Considering the large number of people directly or indirectly employed by the Western automobile industry — estimates range between 1 out of every 7 and 1 out of every 10 people employed — we cannot simply let this happen. New, high-technology industries like advanced electronics, for instance, can in no way offset the losses in this key Western industry — not even if we are better than the Japanese in these newly developing branches of industry.

The paradox here is that that which must not be allowed to happen is precisely what is happening. Given a Japanese cost advantage of \$1,500 to \$2,000 per car, including shipment to Europe or the United States, and considering some governments — with the United States and the FRG at the head of the list — which hold the view that the auto industry should solve its problems by itself, if you please, it is only a matter of time until this very situation comes to pass.

We must not be deceived by the trend this year, because rising prices and supply cutbacks will cause the Japanese market share to decline slightly. But this in no way solves the problem. The Japanese are simply aware of the potential reaction and have consequently become somewhat "more cautious" for the moment.

Fig. 1. Subcontractors from A to Z, from Exhaust to Central Locking System
 — Important parts not produced at the automobile plant
 (Example used: 5-door Ford Escort)



Key:

- | | |
|--------------------------------|------------------------------------|
| 1. Electrical system | 22. Metal seat fittings and tracks |
| 2. Air filter | 23. Steering wheel |
| 3. Battery | 24. Carpet |
| 4. Heating, ventilation | 25. Door hinges |
| 5. Windshield wipers | 26. Insulation materials |
| 6. Safety glass | 27. Brakes |
| 7. Electronic instrument panel | 28. Disc brakes |
| 8. Electric window control | 29. Drive mechanism |
| 9. Safety belt | 30. Fuel pump |
| 10. Sunroof | 31. Clutch |
| 11. Seat frame | 32. Blinkers |
| 12. Trunk floor covering | 33. Headlights |
| 13. Rear window wiper | 34. Source: Ford |
| 14. Bumpers | |
| 15. Taillights | |
| 16. Tires | |
| 17. Brake drums | |
| 18. Shock absorbers | |
| 19. Springs | |
| 20. Exhaust system | |
| 21. Central locking system | |

We have to accept the fact that the Japanese conquest of the world's automobile markets can be attributed not to "dumping" but to the supply of competitive products. To be sure, until the end of the 1970's the Japanese had directly and indirectly practiced the most comprehensive and uncompromising protectionism for the benefit of their auto industry. And where were the advocates of free trade then, when we needed them?

The Japanese installed highly automated apparatus and installations. They built up efficient subcontractor industries, normally located in the immediate vicinity of the automobile companies. A pronounced sense of national solidarity, the willingness to subordinate personal demands to team interests and the community effort for the company and for Japan characterized the attitude of company managements and trade unions alike. In Japan, the dispute over who gets how much of the "pie" takes a back seat to the consideration of how the pie might be made bigger.

At the same time, during a long boom fueled by cheap oil, we in the West approved liberal increases in the size of staff departments, continuously more generous social programs, countless legislative regulations, wage and salary increases, health and safety legislation, longer vacations and shorter working hours — all of which are certainly desirable things to have, but which also drive up costs and reduce productivity. They do indeed improve the quality of life, but definitely not the balance of payments.

Before I am accused of the usual capitalist exercise of shifting all the blame onto the work force and the unions, I should like to make it clear that Western management has also contributed its share to this whole set of problems. During the comparatively "easy" years, we in management were too cautious, too systematic and excessively analytical.

But why should we take risks of any kind in times of problem-free expansion? Why should we introduce totally new and revolutionary products and production processes — which, moreover, pay off only in the long run, and then with a question mark — if a less revolutionary product with fewer changes engenders lower costs and, to boot, produces an even greater short-term return?

Since we need so many analyses in our steadily growing companies, why should we not permit ourselves the luxury of extravagant staff departments? And finally, why should we push automation of the plants when it costs so much money and when, moreover, this troublesome subject meets with such precious little approval from the unions because of the possible elimination of jobs?

Regardless of whether the error lies with labor, the unions, governments or management — or with all of them — the fact is that the Japanese auto industry is producing between 40 and 50 vehicles per employee per year — compared to between 12 and 15 per employee per year for those European manufacturers with particularly efficient operations.

It is true that the Japanese purchase more on the outside and that their companies tend to be assembly plants rather than complete, heavily structured manufacturers. But this amounts to a maximum of 5 to 10 cars when "vehicles per employee per year" are figured.

We are going to have to increase our work effort and our productivity drastically. This applies equally to management and labor.

In 1980, Ford produced a scant 1.5 million cars and trucks in Europe — with a work force of around 140,000. Toyo Kogyo, the manufacturer of Mazda vehicles, built 1.1 million cars with 22,000 employees in 1980. Hard to believe, but true.

It must be remembered in this regard that Ford is one of the most efficient and productive manufacturers in Europe. The conclusion is obvious: In the future, management and the work force cannot get around operating with fewer personnel while still expanding production.

This touches upon the next essential step: the necessity of investing on a massive scale in new manufacturing technologies and new products that will dispel our conservative notions of the past. These parallel efforts to introduce new products and new manufacturing installations will tax the automobile industry's financial reserves to their utmost limits. This complete retooling for the manufacturer of totally new products in brand new plants also accounts for the \$80 billion now having to be spent in the United States.

Moreover, the European and American automakers must learn to swallow their often considerable pride and work together constructively so that joint investments may be made and costs reduced. Collective use of the same four- and six-cylinder engines by Volvo, Renault and Peugeot is an excellent example of this kind of cooperation.

This trend will continue and intensify. In addition, the European producers should basically be prepared to join with Japanese companies in order to assure their economic survival either as whole companies or at least as import companies. This will be especially true if the Western governments decide to sacrifice their auto industries on the altar of the pure free-trade doctrine.

None of the aforementioned measures — neither the new models, the new plants nor the reduced work forces — will be enough to close the productivity gap adequately. For the main problem affecting us is ultimately one of social policy, thus involving factors that clearly lie outside the sphere of control of the automobile industry.

We in the West have an innate appreciation of individualism and individual accomplishments. One of the reasons for this lies with our agricultural heritage, wherein every farmer worked his own land and raised his own sheep or cattle. The situation was not the same in Japan: For hundreds of years the growing of rice required a communal effort, with every member of the community taking turns working in every other member's paddies.

When this ancient institution is combined with Japan's lack of natural resources and arable land, as well as its own view of itself as an insular kingdom, the result is a society with the collective conviction that its strength lies exclusively in subordinating the individual to the needs and desires of the community.

This is not exactly a Western concept. Nevertheless, it is reminiscent in a certain way of Marxist thought — with the fine distinction that Japan, as a collective society, does not exhibit the fictions and inefficiencies of Marxist-oriented economies, and that its system of allocating economic productive forces and financial

means -- investments, profits, penalties and rewards -- is effectively capitalistic through and through.

We are thus faced with a society that combines with the efficiency of capitalism socialism's sought-after but never attained spirit of "all for one, and one for all."

The European governments have blessed the industry with strong, independent trade unions, increasingly shorter work weeks and an abundance of laws favorable to labor -- including the one that requires the continued payment of sick pay without verification of illness. All of these things are wonderful if a society can afford them.

But how is our present system of society -- one characterized by a 39-hour work week, a 10-minute break every hour, longer and longer vacations, absentee rates between 10 and 25 percent in most of the Western countries and union opposition to job cuts resulting from automation -- how is this form of society supposed to prevail against another form in which employees advertise a "strike" by wearing "protest" armbands while they work, in which they willingly work overtime, in which the trade unions regard their primary aim to be that of "keeping their company healthy," in which workers and management use vacation days to complete an especially important job, in which only some of the employees belong to the permanent work force ("a job for life"), and one in which many small subcontractors use low-paid housewives as a principal labor factor without accruing additional personnel costs.

The answer is clear: Left to its own devices, the Western auto industry cannot compensate for the discrepancies between Western culture and the resolute sense of joint responsibility found in the Japanese social system.

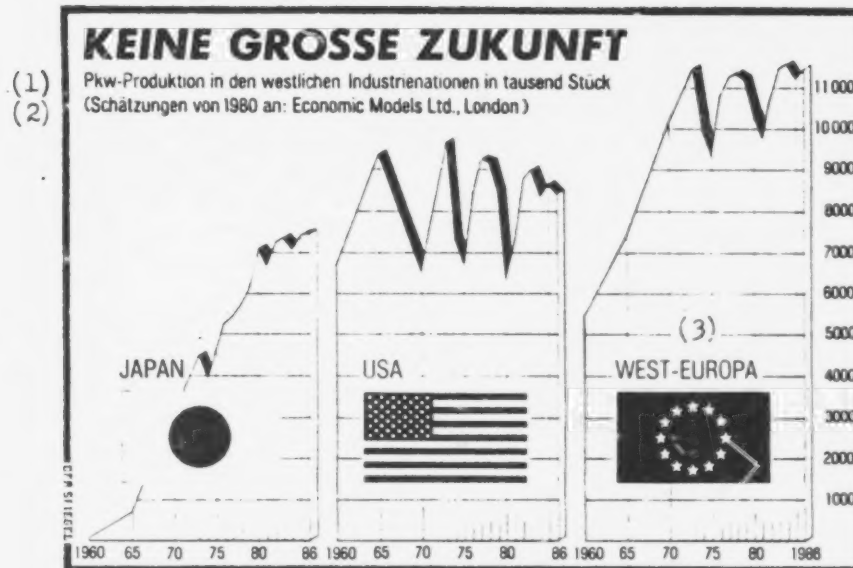
Nothing in life is perfect -- not even Japanese society, let alone Japanese vehicles. Cars and motorcycles from Japan are subject to a rapid and increasingly faster succession of cosmetic changes as well as a bewildering array of models, body designs and names.

The almost constant model changes -- together with the many different models themselves -- are a source of insecurity for the consumer, for this situation complicates customer service and spare-parts supply. It prevents the development of a clear product image, which in turn results in a lower resale value.

Moreover, there are growing indications that we need not exactly hide in shame in the face of Japanese quality -- especially when it comes to durability. We have only to see to it that our little individualistic Western assembly foul-ups are kept out of our vehicles and that we are able to maintain our technical lead in the area of dynamic handling characteristics -- though it would be a mistake to consider the latter a sure thing.

There are also indications that Japanese society is gradually "becoming Westernized." For example, older supervisors are seeing a decline in the way their younger subordinates view their work as well as in their enthusiasm for the work. The Japanese establishment is shocked when it hears about schoolboys who beat up their teachers because of dissatisfaction with a conformist, achievement-oriented social system -- as happened only recently. And it has also been observed that the Japanese seem to be trying to get more leisure time to show off their designer jeans and their Gucci belts and purses. At most, however, this is just the beginning of a long evolutionary process.

Fig. 2. Future Not Good



Key:

1. Automobile production in the Western industrial nations — in thousands
2. Estimates beginning in 1980 provided by Economic Models Ltd, London
3. Western Europe

In any event, the transition from a monolithic, disciplined social system to a pluralistic and individualistic society along the lines of Western society will never be made in time to save the West's industry — if the transition ever becomes complete at all.

Whether we call it protectionism, fair marketing, restrained marketing, self-imposed restrictions or anything else — we must nevertheless take steps to prevent our Western domestic markets from being flooded with Japanese cars. Would that signify the end of free trade — as we know it — not to mention a disaster for the West, especially for the Federal Republic of Germany?

I categorically refuse to believe that.

Many industries throughout the world are protected in the most varied ways for reasons of national interest. I can think of agriculture, for example, or the 50-cubic-centimeter "Mofas" and "Mokicks," or other small motorized two-wheelers that are profiting from national legislation designed to keep them alive. I would bet anything that an accurate analysis of EC or U.S. trade would turn up hundreds of industries that are protected in some form or another because they are considered "worthy of survival," for economic reasons or for reasons of emotion or tradition.

If we make it clear to the Japanese that we are not willing to see our industry destroyed, it will not unleash the often feared "trade war," for the Japanese have been waiting for these very instructions. After all, they too have to plan their activities. If they do not receive these instructions, they will continue on with their expansion. The FRG's dependence on exports, often cited in this context, has nothing to do with the case.

A large share of the FRG's industrial exports goes to other EC countries or to the United States, and consequently can scarcely be affected by EC or Euro-American trade restrictions on Japanese automobile products. As traditional trading nations, Italy, Spain and France have indeed done rather well for themselves even though they allow only a few Japanese car and truck imports — or none at all.

The governments of the Western world must now decide whether what they want in the future is a fully functioning automobile industry or merely an import and assembly industry.

And before they decide to sacrifice the auto industry altogether, they should weigh carefully whether there are other "growth industries" that can absorb all those millions of jobs that would result if the Western automobile industry were to go under.

I can only hope that they will find such industries. Moreover, I would love to know which ones they might be. It is a dead certainty that we can keep neither the United States nor Europe alive with designer jeans, McDonald's hamburgers or pop groups.

And the unions, too, must finally decide whether they want higher and higher wages, shorter and shorter work weeks and numerous other amenities, or whether they wish to preserve one job or another in a viable automobile industry. For we can unfortunately no longer afford both at the same time in the Western world.

In the future we shall be able to afford neither the high cost of the disputes about who is to get which piece of the pie — in other words, the constant testing of strength between labor and management, between government and business — nor the cost of shorter work weeks and dubious sick leave, nor the cost of our egotistical, flagging affluent society — a society that still works more efficiently than socialism, but definitely not more efficiently than Japan's.

The fact is that we will not be able to afford all the benefits and costs of our social system if we simultaneously import and sell goods produced by a society that is much more industrious and less self-seeking. This will work only for a short time.

In the medium term we shall be transferring to Japan our jobs in industry, our purchasing power, our industrial base and our entire prosperity.

The choice lies with those Western governments that have still not seen the handwriting on the wall.

Would these governments please inform the automobile manufacturers of their decisions as soon as possible? Because we have to make some decisions about where in the world we are going to be building our cars in the future.

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26 August 1981

West Europe Report

SCIENCE AND TECHNOLOGY

No. 71



FOREIGN BROADCAST INFORMATION SERVICE

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26 August 1981

WEST EUROPE REPORT SCIENCE AND TECHNOLOGY

No. 71

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ENERGY

RESULTS OF NATIONAL WIND ENERGY RESEARCH PROGRAM REPORTED

Various Techniques Explored

Amstelveen ENERGIE SPECTRUM in Dutch Jun 81 pp 163-167

[Speech by J. Pelser, director of ECN, on 18 May 1981, during conference on "Wind Energy in the Netherlands"; place of speech not given]

[Text] The text of this article was taken from a speech, given by engineer J. Pelser, director of the ECN [Netherlands Energy Research Center] on 18 May, during the conference on "Wind Energy in the Netherlands." Following the report on 5 years of the National Wind Energy Research Program, this conference provided a detailed analysis of the report in question and related aspects.

In 1976, the National Wind Energy Research Program got off the ground by defining a number of research projects, which have currently been totally or largely completed. Special mention should be given to the research on storage systems. In 1975, the Project Preparation Group advocated exploratory research on high capacity storage systems, in relation to which the view was expressed that, given the small differences in altitude in the Netherlands, the probability of water being pumped up into reservoirs would be nonexistent. Since 1979, there has been a plan, presented by engineer Lieveense, in which he proposed a combination of wind energy and storage basin accumulation. Meanwhile, a report on this plan has been issued by the Committee for the Preliminary Study of the Lieveense Plan; the proposed storage method is very interesting, because in this way a number of objections relating to the implementation of wind energy can be cleared away.

Meteorology

Within the framework of the National Wind Energy Research Program, the KNMI [Royal Dutch Meteorological Institute] has gathered the wind data most relevant for the Netherlands, put them into more usable form, and further elaborated on them. These activities involve the reduction of wind data, as they have been measured for years by the KNMI, on the one hand into representative velocities as they would occur in open terrain and, on the other hand, into velocities at an altitude of 40 meters. Furthermore, the distribution of the wind velocity in terms of the direction of the wind, and the distribution of low wind periods were studied. Attention was also given to data obtained from measurements over the North Sea.

The conclusion we can draw is that a number of existing data have been processed in such a way that a usable package of information, necessary for the implementation of wind energy, has been developed. Alas, no specifically new data have become available within the framework of this research program, which would be significant for the generation of energy with the aid of wind. This involves, among other things, measurements at a 40 meter altitude level, in order to be able to verify the results calculated within the framework of the program. Neither has any new information become available with regard to expectations of the short term wind supply and its behavior over short periods of time. The limited capacity of the KNMI to carry out research and various other priorities have had a limiting influence here. These data are very important, specifically for the application of wind turbines and parks, whereby energy is delivered to the public system. A further study of this will be necessary.

Technology

This subject can be divided into three areas. The wind turbine with horizontal axis, the wind turbine with vertical axis, and a new development in the area of the wind turbine with horizontal axis -- the so-called tip-vane system. The most advanced in development is the wind turbine with horizontal axis. Such a turbine, with a rotor diameter of 25 meters and a 300 kilowatt electric generator, was designed within the framework of the National Wind Energy Research Program, built and set up on ECN land in Petten. The goal was not to build a prototype production machine, but rather to develop a measuring installation in preparation for the construction of wind turbines of greater size and capacity.

This is why this wind turbine has been equipped with elaborate instrumentation, in order to be able to register clearly its behavior during periods of fluctuating wind loads. Moreover, this machine will make it possible to check the manner in which the turbine should be regulated, in order to deliver an optimum amount of electrical energy to the system.

The design, calculations and building of this wind turbine have provided important experience, which will be very useful for the future industrial production of wind turbines. Based on the currently available data, they could simply build a wind turbine with a 25 meter diameter for the production of electricity. When the measurement data of the turbine located in Petten become available shortly, it will also be possible to design and build larger wind turbines, with a capacity of, for example, up to 1 megawatt. In order specifically to give industry in the meantime the opportunity to learn to manage the larger scale production of wind turbines and to get to know the behavior of a number of wind turbines working together, it will be necessary to proceed as soon as possible with the building of a park with, for example, 25 turbines with a capacity of 300 kilowatts each.

Also important are the studies which have been carried out concerning the conversion of mechanical into electrical energy. These have provided insights into the possible application of a synchronous rotary generator with post-connected battery-charger and alternator, which would allow for a considerably improved coupling with the system compared with the synchronous or a-synchronous rotary generator, directly coupled to the system, generally used abroad. Measurements obtained from the 25 meter wind turbine in Petten should provide a definite answer to the question of whether this is indeed the case.

Technology (mechanical) I

Activities	: 25 meter horizontal axis turbine designed and built
Results	: unique measuring instrument
Sequel	: operating results

Tip-Vane System

Pioneering work has been done by the staff of the Technical College at Delft. By fastening small auxiliary wings to the ends of the rotor blades of a wind turbine, it became possible to increase substantially the quantity of air going through the rotor. This way, the same diameter rotor could produce a substantially larger quantity of energy. This could, for example, result in a 60 to 70 percent increase of the energy yield at an estimated 15 percent increase in costs. A great deal of research remains to be done before this principle can be applied in the production of wind turbines. Due to the expected reduction of energy costs, it is extremely important that this research be continued further.

Technology (mechanical) II

Activities	: development of tip-vane rotor
Results	: working of tip-vanes established
Sequel	: demonstration

Vertical Axis Wind Turbine

This turbine is based on a principle which was already patented in 1929 by the Frenchman Darrieus. However, it took until 1975 for this system to be rediscovered by the Canadians. Since then, research on it has been conducted in a number of locations in the world. In the Netherlands, such a turbine with vertical axis was built during the years 1975 and 1976, in the framework of the National Wind Energy Research Program.

A number of experiments were carried out with this turbine, which had been set up on the property of the Fokker airplane factories at Schiphol. The vibration of the turbine as a whole and of the rotor blades in particular was measured, its behavior in a gale wind under emergency conditions was studied, and the kind and velocity of the wind surrounding the wind turbine were studied with an eye on the wake effect. A number of aspects in the aerodynamics and the aero-elastic behavior of a turbine with vertical axis were not yet known at the time this turbine was designed. The result was that a number of measurements made it clear that it is not always possible to measure that which one would have liked to measure. Thus, no answer could be provided to the question of how to choose the design parameters for scale enlargement. On the other hand, however, the experience obtained with the 5 meter vertical axis turbine was very important for the insights it provided in relation to the choice of instrumentation for the 25 meter horizontal axis turbine in Petten.

Technology (mechanical) III

Activities	: vertical axis wind turbine [VAT] (measurements on 5 meters)
Results	: limited data on VAT
Sequel	: design and construction of 15 meter VAT

Based on the experiences with this 5 meter VAT, Fokker as well as Rijn-Schelde-Verolme have currently developed designs for turbines with vertical axes with a 15 meter diameter and a 25 meter diameter. It would be advisable to build such a wind turbine as soon as possible, in order that the results can be effectively compared with those of the 25 meter turbine with horizontal axis.

Planning and Mutual Influence

Results of the research conducted by a study group, consisting of representatives of the Ministry of Economic Affairs, the National Planning Service, the KEMA [Office for the Inspection of Electrotechnical Material] and the ECN, on the planning aspects of wind energy parks showed that, after eliminating those areas where the construction of wind turbines is absolutely impossible (water, roads, farmland, woodlands), in the zone where the wind velocity is at least 6.5 meters per second, there remains an area which could accomodate a maximum of 30,000 wind turbines if there were no other limitations.

That this does not involve real space is apparent from the fact that about 25 percent of the area involved could be filled with windmill parks. Hence, it is a purely theoretical solution and in practice it would turn out that numerous areas are already being used for purposes which would not readily permit the construction of windmills. Therefore, it seems to me that it would be useful to consider a limited area, for example in the tip of Noord-Holland or in Friesland, in order to make a detailed study there of what the real possibilities for placing wind turbines in an agricultural area are. Furthermore, it is true that, according to the theoretical view, if we limit ourselves to an area where the wind velocity is higher than 7.5 meters per second, this area could accomodate 10,000 wind turbines. Let us assume that 10 percent of that figure is real, then there would still be room for about 1,000 wind turbines. The possibilities of setting up wind turbines in the North Sea have also been looked at. A couple of areas have been noted along the Dutch coast, where at least a few tens of thousands of wind turbines could be built. Technically speaking, the possibilities seem to be there, but in terms of costs it should be expected that the energy produced would cost approximately twice as much as that produced by wind turbines on land. From this point of view, there can be no question for the time being of building wind turbine stations in the North Sea. A great deal of work, the results of which have also been presented in the international framework, has been done on the measuring of wake effects. A good understanding has been acquired of the capacity reduction resulting when the mutual distance between the wind turbines is reduced. As a result of these calculations, it can be said at the present time that the mutual distance can be smaller than had been assumed a number of years ago. Extensive attention was also directed to the turbulence structure behind a single rotor. It showed that this turbulence could well create an extra load on the rotor blades. Further research will yet have to be done to learn about the turbulence in complete windmill parks.

Technology (electrical)

Activities	: conversion of mechanical into electrical energy
Results	: preference for synchronous generator with battery-charger and alternator
Sequel	: experimental verification

Coupling with System

Several figures could apply in terms of the total number of wind turbines which would be used for the public electricity supply of the Netherlands. This also applies to the number of smaller decentralized wind turbines which could be coupled to the public system.

The 1975 report of the Project Preparation Committee on wind energy indicated that in order to generate approximately 20 percent of that year's electricity production with wind turbines, approximately 5,000 wind turbines of 1 megawatt would be required. This report already noted that to set up such a capacity would certainly have consequences for the electricity production system, which should be thoroughly studied. But, it was said, the realization is not unimaginable.

Meteorology

Activities	: existing data processed and reduced to usable form
Results	: usable package of information
Sequel	: specifically new information
	- verification of 40 meter wind velocities
	- short term predictions

However, the National Wind Energy Research Program has brought out the fact that a 5,000 megawatt wind energy capacity is a rather large capacity to be able to be absorbed at all times by the electricity system. If the minimal load is taken into account, then a much lower capacity is arrived at. If it is determined that no more than 20 percent of the peak capacity is ever to be produced through wind energy, then the limit lies somewhere in the neighborhood of 2,000 megawatts. However, if one approaches the matter in a substantially more conservative way and if one assumes that the wind energy capacity is a capacity which could suddenly at any time disappear due to a reduction of wind, then at that point the maximum capacity to be put into service would be the equivalent of the largest conventional unit. As a matter of fact, the structure of the system is currently geared to it and the operation is such that it is possible to absorb the loss of such a capacity. This capacity is approximately 650 megawatts. The question is whether all of this is very real, because under certain circumstances a much larger wind capacity could very definitely be accepted. If, for example, a 3,000 megawatt wind capacity were to be set up, then it would be conceivable that under certain circumstances -- for example, during the summer at minimum load -- its production might have to be limited to 2,000 megawatts. What should be looked into then is what the operating period would be for the 1,000 megawatts which cannot be fully used and whether it would still be profitable to build these wind turbines on the basis of this operating period. It is also very conceivable that under certain circumstances, the wind energy capacity might have to be limited to a capacity substantially below the 2,000 megawatt level. Such a situation could occur if short term wind expectations are for a rapid reduction of wind, while the electricity system expects an increasing power demand, for example between 6 and 8 o'clock in the morning.

Decentralized Applications

Activities	:	testing of windmills at test site in Petten execution of demonstration projects
Results	:	will be obtained only later on from current projects

All of this should have made it clear that the use of wind energy will require a different kind of management in electricity companies than had been the case up to now, and that this management will have to be geared to it, which should be possible without endangering the reliability and operational dependability of the electricity supply. It should be obvious that the presence of energy accumulations in a storage basin would very strongly reduce if not eliminate these problems.

Costs of Wind Energy

The following can be said about the costs related to the generation of wind energy. If the investment in a wind turbine costs 3 million guilders per megawatt, then the cost per kilowatt-hour can be figured at 18 cents. This amount is not a criterion for determining whether wind energy is profitable, if no consideration is given to the fact that a wind turbine can only be considered as a partial replacement for conventional power. The presence of a 1 megawatt wind turbine capacity would mean that approximately 200 kilowatts less conventional power would have to be produced. If we assume the investment in 200 kilowatts of capacity to be 400,000 guilders, then the net investment would amount to 2,600 guilders per kilowatt. This investment would have to be compensated for by a fuel conservation of approximately 8 cents per kilowatt-hour. At the current rate of depreciation, this is not the case. However, if the investment in a wind turbine could be reduced to 2.5 million guilders, then the wind turbine would be profitable at a fuel price of approximately 13 cents.

Planning

Activities	:	research space aspects of large scale application
Results	:	theoretical approach to location possibilities
Sequel	:	detailed studies of real location possibilities

Considering the expected developments it would seem reasonable to assume that this situation will be achieved in a few years. Moreover, the certainty that for a wind turbine the kilowatt-hour price is determined at the time it is being built, that is to say that it is determined solely by investment costs, makes it a possibility that other criteria may have to be applied for the investment decision than is usually the case.

Aside from the large scale application of wind energy, increasing attention is being given to the so-called decentralized application. This could be an autonomous company, thus independent of the electricity system, possibly in combination with a diesel generator, or an application whereby coupling with the system exists anyhow. Both applications could be important for agricultural enterprises, for

drainage of the polders or for isolated housing centers. Generally speaking, the wind turbines used here will not be too large in diameter, that is to say up to, for example, 10 meters and will have a generator capacity of approximately 20 kilowatts. At the present time, a number of enterprises in the Netherlands are intensively pursuing the designing and building of these smaller windmills. These kinds of mills are also being imported from abroad, specifically from Denmark; however, there are no reliable mills on the market yet with a guaranteed working life of, for example, at least 10 years.

Integration with Electricity Supply

Activities	: research on incorporation of wind energy
Results	: capacity to be incorporated under all circumstances is limited
Sequel	: evaluation of operating period as function of wind capacity

Costs of Wind Energy

Activities	: initial cost calculation for large wind turbine
Results	: estimated cost per kilowatt-hour approximately 40 percent higher than with conventional

Mutual Influence

Activities	: calculations and wake measurements in wind tunnels
Results	: good insight into mutual influence of wind turbines
Sequel	: experimental verification in the field

Not much practical experience has been acquired yet either. In addition, there is the specific question of whether the predicted fossil fuel conservation will be realized in practice and whether energy generation with these mills will entail a sufficiently low energy price for the consumer. Hence, in order to develop a sound understanding of the problems related to the decentralized generation of wind energy, it will be necessary to carry out demonstration projects for a number of representative cases. The goal of a demonstration project must not under any circumstances be the testing of certain components, such as the windmill itself. These parts should first be tested separately as to their safety and reliability, for example by a testing company at the ECN testing site in Petten, which is available for that.

Conclusion

As a general evaluation, it can be said that, within the National Wind Energy Research Program, the tasks which were formulated 5 years ago at the start have been carried out, with the exception of the 25 meter turbine with vertical axis project. All the auxiliary tasks have produced important data, all of which is necessary to permit the application of wind energy in the Netherlands. The question of whether

wind energy can make a significant contribution to the energy supply of the Netherlands, can be answered with a straightforward yes, as long as the consequences of this application are accepted.

In closing, one last observation. There are many people in the Netherlands who believe, and rightly so, in the application of wind energy. However, they are apparently divided into a large number of groups. In this context, one might draw attention to a motto from a time when wind energy played an important economic role, specifically the motto of the Republic of the Seven Netherlands "Concordia parvae res crescunt": unity makes the small strong.

Lievense Plan

Amstelveen ENERGIE SPECTRUM in Dutch Jun 81 p 145

[Final Report on proposal by L.W. Lievense, issued by the Committee for the Preliminary Study of the Lievense Plan: "Wind Energy and Water Power"]

[Excerpts] The interdepartmental Committee for the Preliminary Study of the Lievense Plan, set up on 4 June 1980, whose task it was to study the idea presented by engineer L.W. Lievense concerning the implementation of a storage basin for wind energy accumulation, has recently presented a report to the minister of science policy. The following ministries were represented on the committee: Science Policy, Transport and Waterways, and Economic Affairs; in addition, engineer Lievense had a seat on the committee.

Description of System

Based on the original idea of engineer Lievense, the committee's study gradually led to the WESP [Wind Energy and Electricity Storage Basin] system as presented here.

The WESP system consists of:

- a number of groups of wind turbines -- which may or may not be located close to the energy storage basin -- whose generated electricity can be made directly available to the public system, and via this system can also be used to pump up water into the storage basin.
- an energy storage basin, consisting of a water mass surrounded by high levees, in which potential energy can be stored.
- a number of water power stations on the levees of the storage basin, which will use the stored potential energy to produce electricity by letting the water flow off from the high basin down to the surrounding lower water level. Because the hydroturbines are reversible, they can also be used to pump water into the storage basin. To pump the water up, electricity obtained via the public system from wind energy or, if necessary, from conventional power stations during low consumption periods (night current), will be used.

Favorable Prospects

In the letter presented to Minister of Science Policy Van Trier, the Committee for the Preliminary Study of the Lievense Plan concluded in its final report "Wind Energy and Water Power" that "based on the current data, a WESP -- Wind Energy and Electricity Storage Basin -- for the purpose of producing electricity would yield such favorable results that from a financial-economic as well as an energy-political point of view a capacity of 1,600 megawatts within a single structure flow should be effected as soon as possible." This would require a hydro-capacity of 1,600 megawatts and a wind capacity of 2,000 megawatts.

If preparation and execution of the project are tackled with great speed, then the above mentioned capacities could be in production about 1995. If an economic growth of 2 percent per year were to exist, then the capacity in the year 2000 would have to be raised to 2,400 megawatts. This would require a hydro-capacity of 2,400 megawatts and a wind capacity of 3,000 megawatts.

Among the locations studied, the Markermeer is preferred. For this location the committee has predicted that, even with moderate economic growth, by the year 2000 it will present a positive balance of 687 million guilders per year, and with 2 percent economic growth up to a possible 941 million guilders per year, all of this calculated in 1980 guilders. Because of the possible savings on fossil fuels, positive effects of 1 to 2 billion guilders per year may be expected in the balance of payments by the year 2000.

The impact on employment in the Netherlands was estimated at approximately 71,500 man-years for the full implementation. As an additional step in the study of the WESP, the committee deemed it necessary to further study the planning involved and the environmental management which had been inventoried in a tentative study.

According to the letter presented, the committee deemed it equally necessary to pursue the study of, among other things, problems related to:

- wind energy and wind turbines;
- optimalization of the relationships between the wind capacity to be installed and hydro-capacity;
- the civil engineering-technical projects.

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CSO: 3102/363

ENERGY

PRESENT STATE, FUTURE OF SOLAR PHOTOVOLTAICS ASSESSED

Essen ELEKTRONIK-APPLIKATION in German No 4, 1981 pp 28-35

[Article by Holger Zeltwanger: "Photovoltaic Current Generation--A Renewable Energy Source"]

[Text] All industrial countries are making major efforts to develop economical methods for the conversion of solar radiation energy into thermal, electrical, or chemical energy. The most intensive work is being done in the fields of thermal and photovoltaic energy conversion. This technical report deals exclusively with photovoltaic current generation, a renewable energy source which of course is not yet being used on an industrial scale.

It has been estimated that the earth gets a radiation output of 10^{18} kwh per year from the sun. This irradiated energy corresponds roughly to 10,000 times the world's current energy requirement. In western Europe, energy irradiation annually comes to $1.7 \cdot 10^{15}$ kwh and in the FRG it is $2.5 \cdot 10^{14}$ kwh.

Because the earth's temperature on the average is extensively constant, the radiation output must practically be completely returned again into space. About 30 percent of the radiation do not reach the earth's surface due to reflection along the air envelope; another 47 percent of radiation are converted into heat and are reflected again during the night. Most of the remaining 23 percent first of all cause evaporation of water. During subsequent condensation, the stored energy is again released in the form of heat radiation. About 0.2 percent account for the generation of air movement as well as waves and about 0.025 percent account for the photosynthesis of plants.

Available Solar Energy

The sun's radiation output in space is almost constant ($1,353 \text{ W/m}^2$). On the earth, the radiation output and its spectral distribution depend on the particular weather, the seasonally conditioned incoming radiation angle, and the daily duration of sunshine.

Thus, the sun appears for about 3,500 hours per year on the equator. In Munich we have 1,800 hours of sunshine and in the Ruhr region we only have 1,500. The average annual global radiation figure (diffuse radiation + direct solar radiation) in the Sahara is more than $2,200 \text{ kwh/m}^2$ and in Central Europe it is $800\text{--}1,100 \text{ kwh/m}^2$.

To have a possibility for comparison, the following definition was agreed upon: the radiation conditions existing outside the earth's atmosphere are designated as air mass 0 ($AM\ 0 \approx 1.35\ \text{kw/m}^2$). The most favorable incoming radiation condition on the earth's surface is ($AM\ 0 \approx 1\ \text{kw/m}^2$) with perpendicular incidence and a clear sky.

If the incoming radiation angle is smaller than 90° , then we get AM values which result from the reciprocal value of the cosine of the incoming radiation angle. $AM\ 2\ (0.75\ \text{kw/m}^2)$ thus represents an incoming radiation angle of 60° ; this value applies in the FRG during the summer months. With a slightly overcast sky in the summer, the radiation output is still $300\text{--}600\ \text{W/m}^2$. In case of heavy cloud cover, we have $100\text{--}300\ \text{W/m}^2$ and during the winter months we can figure about half of that.

In spite of the gigantic energy volume, which the sun radiates upon the earth, solar energy is so far hardly being used. Only the rising cost of fossil energy sources (oil and coal) and the continuing criticism of atomic energy push the use of solar energy.

The principle of photovoltaic current generation has been known for more than 100 years. So far, solar cells however have been used only in isolated cases for space travel. These solar cells now cannot be used for terrestrial purposes because, on earth, we have a spectral energy distribution of sun rays which is different from what it is in outer space.

Current Status

The three biggest solar cell producers are affiliates of American oil corporations such as Solarex Corp. (Amoco affiliate), Solar Power Corp. (Exxon affiliate), and Arco Solar Inc. (Atlantic Richfield affiliate). Each of these firms has an approximate annual output capacity of 1 Mw. Worldwide, 5-6 Mw were produced last year.

In Europe, it is especially AEG [General Electric Company] and RTC (until now a Philips affiliate) which are involved in the production of solar cells. A short time ago, Siemens also ventured into this business. According to statements by Solartechnik sales manager Klaus Kaesen, Siemens is setting up a production facility of its own in Regensburg. Production is scheduled to start in 1982. Until now, Siemens had been getting its solar cells from Valvo/Philips, with whom a semiconductor delivery agreement had existed for the past 15 years.

In view of the dominant position of American oil affiliates, Kontron production manager for Solarsysteme Georg Schmidt, thinks that "the electric power industry has been asleep at the switch." Indeed, we cannot see much of AEG here and Siemens has just jumped on the solar bandwagon. The people at Siemens do not consider this necessarily as a disadvantage. According to Klaus Kaesen, Siemens considers solar electronics to be a system operation which is why they think they are superior to some extent to the oil affiliates. He does of course expect the oil corporations to work with the electric power corporations once the industrialization of photovoltaics begins.

But it is not quite correct to blame the German electric power industry alone for all it has failed to do although it did put its cards on atomic energy for entirely too long and in too exclusive a fashion.

The West German government's promotion policy also leaves something to be desired. On the one hand, they recognized the possibilities of photovoltaics far too late and on the other hand many people criticized the way in which money is being given out. In the FRG, AEG-Telefunken and Heliotronic, an affiliate of Wacker-Chemitronic GmbH [Incorporated] were commissioned early in 1978 to conduct "an investigation and the development of industrial manufacturing technologies for terrestrial solar cell generators and the suitable basic materials."

It is not yet certain to what extent Siemens is being subsidized.

In the United States, in addition to annual subsidies of \$250 million, other important decisions are being made which are designed to make the use of solar cells attractive. For example, the electric power companies must purchase energy generated from private individuals by means of solar cells at favorable prices. Another way to make the use of solar electronics worthwhile would be to have your "house" (local grid) disconnected from the public grid in order to be able to switch to your own supply system, at least during the noon hours. It is especially the smaller companies which today already market solar cells in the FRG and which complain that the promotion funds are not being scattered widely enough and that users are not being sufficiently subsidized. Early this year, EG however adopted 18 projects with 1.4 Mw in which the West German government is also participating.

"There is too little promotion work being done," complained Helmut Rechberger, the business manager of Atec GmbH and with tears in his eyes looks to France where the government publishes official government advertising pamphlets. "That sort of thing costs a lot of money and this is what the small companies have to do in the FRG themselves," according to Helmut Rechberger. Joachim M. Tuebcke, the business manager of Solarelektronik GmbH, feels that the big companies, especially AEG, are getting preference in the federal government's promotion policy.

Prognoses and Estimates

Siemens expects a world output growth rate of 2.5 per year until 1985. After that, the growth rate will level off somewhat. According to Klaus Kaesen, they expect a world market of 20-25 Gw for the year 1990.

Wacker-Chemitronic is somewhat less optimistic; that is one of the most important raw material suppliers for solar cells. For the year 1990, the Solar-Material sales manager Norbert Ayberger predicts a worldwide output volume of 100 Mw. The American DOE is about as optimistic as Siemens and predicted a production volume of 500 Mw for 1985.

Although Fritz G. Vieweg-Gutberlet, the technical marketing manager, claims that "Wacker-Chemitronic is aware of the obligations to meet the need for silicon," one may certainly doubt that the efforts of silicon suppliers will be sufficient to attain the figures predicted by Siemens and the DOE. This is especially true since, according to the 1982 Schuhmacher report, we can expect for the first time that the requirement curve for silicon (excluding solar cells) will by far exceed the installed capacity worldwide. Even though doubt has been voiced in the meantime about the report, this mostly involves only a time shift of 1-2 years.

Nevertheless, the efforts made by Wacker-Chemitronic are quite considerable. By the end of 1981, the production capacity for polycrystalline silicon at Burghausen is to be increased from 1,200 today to 1,800 t/yr. Besides, a new factory is being built in Portland, Oregon, which is likewise supposed to supply polycrystalline silicon by 1983. For comparison: last year, about 3,000 t of polycrystalline silicon were produced in the western world, including Japan.

The central point as to whether photovoltaic current generation can provide an essential portion of energy generation involves economy. Because silicon will remain the basic raw material for solar cells, the following figures relate to this basic material. It has not yet been finally decided whether monocrystalline or polycrystalline silicon or some other technology will prevail. But the basic material will probably remain silicon.

We distinguish between the costs for solar cells and the module costs whereby, according to data from Siemens, 40 percent of the module costs go for silicon, 30 percent for cell production, and 30 percent for module production. Klaus Kaesen starts with the assumption that "silicon, as basic material, can be reduced in terms of cost by a factor of 10 if one arranges the highly energy-intensive purification processes in a somewhat more clever fashion." By the middle of the eighties, the Siemens sales manager expects a solar cell price of DM 3-5/Wp (W_p = electric output of one solar cell under AM 1 conditions, that is, $AM\ 1 \approx 1\text{ kW/m}^2$). Today, the costs are about DM25/Wp and 10 years ago they were still DM2,000/Wp. Looking at panels, the price today is DM30-50/Wp. Professor Hans-Joachim Queisser of the Max Planck Institute in Stuttgart even expects a price reduction down to DM1/Wp for the cost of the cells by 1985. Wacker-Chemitronic expects a price development for solar cells which is illustrated in Figure 7.

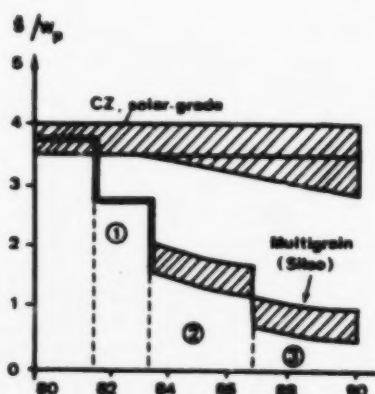


Figure 7. Price prediction for solar cells: 1. Improved casting processes; 2. Better methods for disc production and cheaper raw materials; 3. Use of "Silso" (Factory photo by Wacker-Chemitronic).

Freddy Jaeger, a staff member at the Fraunhofer Institute of System Engineering and Innovation Research, expects a panel price of \$1-2/Wp by 1990. Figure 8 illustrates the expectations of the Department of Energy which is similar to those of Siemens. Valvo assumes that a price drop of 20 percent per year by the end of the eighties is not entirely unrealistic.

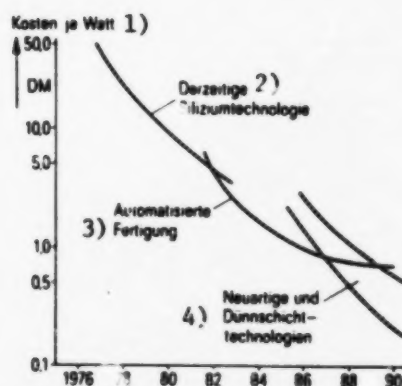


Figure 8. Cost prediction for solar cells by Department of Energy, U.S.A. (source: Siemens. Key: 1--Cost per watt; 2--current silicon technology; 3--automated production; 4--novel and thin-layer technologies.

There are various economy limits also for differing uses. In the case of "island solutions" and for uses where there is no central supply network, the solar cell today already is an alternative for other energy sources (Figure 9). Uses in private households according to an American study become worthwhile only if the system costs are around \$1/Wp. Solar cell systems for central current generation are profitable only if the system costs drop below \$1/Wp. This, according to the study, will not happen before 1990.

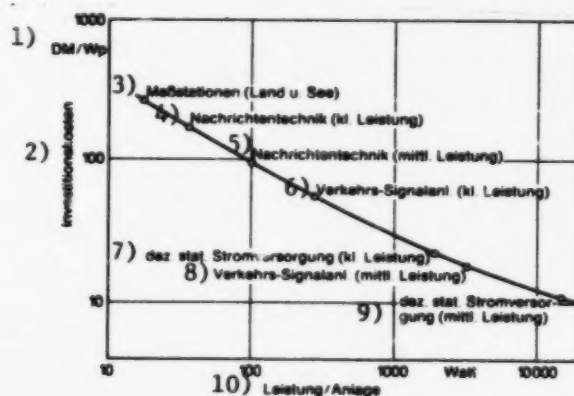


Figure 9. How big would the investment costs for solar systems be in connection with various uses? (Factory illustration: Siemens). Key: 1--DM/Wp; 2--investment costs; 3--measuring stations (on land and on the sea); 4--communications equipment (small output); 5--communications equipment (medium output); 6--traffic signal systems (small output); 7--decentralized stationary current supply (small output); 8--traffic signal system (medium output); 9--decentralized stationary current supply (medium output); 10--output per plant.

Uses

At this time, photovoltaic current generation is still in the preindustrial stage. "In the FRG, the emphasis is still on the sparetime sector," according to Joachim

M. Tuebke, business manager of Solarelektronik GmbH, "and the export business is only in its beginnings." The other suppliers of solar cells and modules likewise consider the domestic market to be mostly a type of consumer business deal. According to Kontron staff member Georg Schmidt, "industrial projects have long start-up times and the export business is still in the pilot stage." Nevertheless, Kontron already has 40 percent of its sales volume in the export business. Those of course are indirect exports, in other words, solar modules are sold to companies which then export solar systems plus water pump or television transmitter.

Siemens thinks in terms of world market criteria and believes that the main sales region for solar systems will be between the two 40th degrees latitude. This results in the following major points of utilization:

Systems for irrigation and drinking water procurement;

Systems for the supply of consumers far from the public grid or who are difficult to reach, such as measurement stations and communications equipment facilities;

Supply of "island networks" in the countries of the Third World.

M. Guenther, the product manager of the Sonnenschein Storage Battery Factory, estimates the market potential for solar-energy-supplied current supply systems at \$100 million by 1985.

Consumer Sector

The solar cells used for energy supply in wristwatches and pocket computers probably represent the type of use involving the least electrical output. Such watches and pocket computers can be purchased already today.

Other products, which in the future are to be equipped with solar cells, are small radios, IR remote-control transmitters, flashlights, motion picture cameras, etc. In order to provide intermediate storage for energy, we use NiCd batteries. By replacing short-life dry batteries with long-life storage batteries we can also reduce the environmental pollution.

A second attractive market for the consumer industry, according to Siemens, is to be found in the recreation field, for example, charge units for batteries on sailboats, in campers, vacation homes, and mountain cabins. But the solar cell has no chance where the electrical power supply network already exists.

There are utilization possibilities also in agriculture, for example, electrical pasture fences, fish weirs ventilation, irrigation of orchards and vineyards.

'Solar Homes'

For some time now, there have been "solar houses" in the United States whose electrical and thermal energy needs are covered at least partly with solar cells and solar collectors [panels] (in thermal terms). In Germany likewise, several companies are selling roofing tiles with built-in solar cells.

The biggest private photovoltaic system in the FRG is in Birnbach. It consists of 36 modules at 33 Wp, each.

If solar cells are to be used also in normal households, several problems have to be solved. Because the solar cells supply DC and because most consumers today need AC, the direct voltage must be converted into alternating voltage or you need new household appliances which will be operated through a second network for direct voltage. In the first case, a way would also have to be found either to feed the locally generated energy into the public grid or to separate the local network (house) from the public grid. This is not so much a technical but rather a political problem.

In order to make the use of solar cells more attractive, electrical appliances would also have to be changed. At this time, luminescence lamps are being developed and they have five times the light yield compared to the old product. Here is how Joachim M. Tuebke expresses it: "We must learn to handle power economically."

Some of the uses which as yet should not be taken quite seriously involve solar-energy-driven mopeds and four-wheeled vehicles. A single-seat aircraft, whose electric motor is driven by current from solar cells on the wings, already has its maiden flight behind it.

The Suntronic Company in Hamburg has just tested a four-wheel mobile and after successful completion, a solar-energy-driven vehicle for disabled persons is to be developed.

Pilot Projects

It is especially the Department of Energy of the United States which has supported a series of pilot projects. Early this year, EG also launched a major program totaling 18 projects with an installed output of 1.4 Mw. Most pilot projects involve power supply systems for use in the Third World.

Pumping systems with just about 1 kw have been installed already by almost all solar cell producers, for example, in Mali (Solar Power) or on Corsica (RTC). Another example involves the 24-USW stations in Australia (Solar Power), whereby more than 1 kw of output is produced in every station. Arco has built up a photovoltaic system (about 11 kw) to supply a directional radio system. This 360-km long directional radio link (Saudi Arabia--Sudan) has been working perfectly since 1979. Many of the pilot systems are power supply units for communications systems, for example, microwave amplifiers, radio and television converters.

A study by SEL AG on primary supply for directional radio systems shows how interested the communications equipment industry is in this development. According to that study, solar generators will be competitive in 1988 against 450-w double-diesel systems.

Several solar systems have also been installed in the United States and Europe, for example, an energy supply system for a gas station in West Chicago with an output of 5 kw (Solarex). Another example is a solar generator with 90 w for a cathodic corrosion protection system on a bridge along the George Washington Memorial Parkway (Solarex).

In France, stationary solar generators are being used for energy supply at railroad crossings (RTC). In the FRG, AEG has equipped some of the emergency phones in the Black Forest and light buoys for the North Sea with solar cells. Siemens recently laid a telephone line to a mountain cabin in the Alps which is operated with solar energy.

Solar Power Plants

Small photovoltaic power plants with outputs of up to 360 kw are under construction and partly also already in operation in the United States. Photovoltaic generators are probably being used here with concentrators. Sunlight is concentrated with the help of reflectors or lenses and only then is it aimed at the solar cells. Larger systems of up to several Mw will not be completed before 1990.

Solar power plants in desert regions, which generate hydrogen through electrolysis and solar power plants in outer space likewise are still only projects which are far off in the future. In the case of the hydrogen plantations, electric energy is to be used to produce hydrogen through the electrolysis of water or acids and that hydrogen is supposed to be stored, condensed, and transported. Photovoltaic power plants, which would circle the earth as satellites, are supposed to convert the incoming solar energy into microwaves and are supposed to transfer it in the form of beams to a receiving station on earth. Of course there is no information as yet on the influence of the microwave ray upon the ionosphere and the extent to which radio traffic and radio astronomy could thus be disturbed. Likewise unsolved is the problem of preventing deviations of the microwave ray from the receiving antenna to avoid damage to human beings and animals.

The main problem in solar power plants is storage. The operation of earth-bound photovoltaic power plants will presumably take place in conjunction with thermal power plants. The latter could then balance out the fluctuations in solar energy and solar power plants could work without storage units. Another possibility consists of pump storage plants which have for a long time been used to store surplus energy.

The Solar Cell Is the Heart

The heart of a photovoltaic system is the solar cell. Here we have precision semiconductors which convert the incident light rays into electric energy. They supply a voltage which is independent of the cell surface. The current generated on the other hand is directly proportional to the surface and the radiation intensity. In case of optimum insolation, the current densities of silicon cells--hitherto used most frequently--are about 25-30 ma/cm². The voltage is about 0.5 v. The lifetime is between 10 and 20 years.

So far, solar cells have been built up as large-surface semiconductor diodes with a homogeneous pn transition. But there are also experiments to make other cells in order to achieve greater efficiency or to be able to save certain steps in the process. Examples are Schottky diodes, tandem cells (two p-n transitions), cells with vertical transitions, and cells with multiple transitions.

The efforts of solar cell producers and raw material suppliers are all aimed at developing cheaper initial materials and attaining higher efficiencies. The industry is being supported here by research institutes, such as, for example, the Max Planck Institute for Solid Body Research in Stuttgart. Another decisive factor is whether the method is suitable for automated production.

In the case of solar cells made of silicon, we distinguish monocrystalline and polycrystalline silicon. So far, we have mostly been using monocrystalline silicon.

Solarex is now also delivering a semicrystalline cell. AEG likewise has established a production facility for polycrystalline solar cells; the silicon for this is being delivered by Helitronic GmbH. Because it has not yet been decided which technology will prevail, many producers work with both materials.

Silicon Cells

Because silicon, after oxygen, is the second-most-frequent element in the earth's crust, there are actually no raw material problems. The starting material mostly is quartz sand (SiO_2). Through reduction with coal in a light arc furnace, we get so-called metallurgical silicon. Through reduction with hydrochloric acid, trichlorsilane is being produced at 300°C . After purification, silicon rods are made at temperatures of around $1,000^\circ \text{C}$ through reduction with hydrogen. Now we have polycrystalline silicon.

To get monocrystalline silicon, the polycrystalline silicon must be melted in a pot. A monocrystalline rod is then drawn out of the melted substance. Another possibility is to draw a melting zone through the polycrystalline silicon rod through which crystallization to form a monocrystal will take place. These rods are cut into discs, polished, and cleaned. Afterward, a phosphorous layer is diffused into the discs, and the p-n transition is thus established.

The reverse side of the cell is completely metallized for electrical contacting. The other side is provided with metallic conductor strips and with an anti-reflection layer. Through this anti-reflection layer and by roughing up the surface, we can reduce reflection losses. The efficiency of monocrystalline silicon cells is theoretically at 22 percent. Under production conditions, we can currently get 12-16 percent. These numbers apply to the presently customary 4-inch discs.

The production costs for silicon solar cells consist of 33 percent for silicon discs, 57 percent for cell production, and 10 percent for other materials. Measures to reduce the cost therefore will be undertaken mostly in connection with cell production and the production of silicon discs. One should above all avoid energy-intensive purification processes.

To save material, some producers are considering a reduction in the cell thickness from $350 \mu\text{m}$ to $50 \mu\text{m}$. The development of methods for the encapsulation of cells is also in its beginnings.

In order to save costs during material production, we try to use silicon with lesser chemical purity. Besides, we are working on new methods for procuring polycrystalline silicon. During mechanical processing--especially during sawing--one can save costs, for example, by reducing the width of the cut, by increasing the cutting speed, or by using multiple wire saws. Another way is to draw the silicon crystals out of the melted substance in the form of strips which eliminates the sawing costs. The starting material however has to be highly purified silicon.

To save process steps, we can also cast the silicon into tube-shaped blocks and sheets. The blocks of course must be broken down into discs by sawing. Wacker-Chemitronic/Heliotronic calls cast silicon by the name of "Silso" (silicon for solar uses).

Thin-Layer Cells

Thin-layer cells consist of an active or passive substrate, upon which thin polycrystalline or amorphous layers are steamed or dusted. One can also apply these layers through pyrolysis or electrolysis. We distinguish between cadmium sulfide, gallium arsenide, and polycrystalline silicon as well as cells made of amorphous silicon.

In the case of the CdS cells, we expect that we can achieve an efficiency of 10 percent. Of course, this efficiency depends heavily on the temperature. Another advantage consists of the toxicity and the very limited supply of cadmium. The situation is similar in the case of GaAs cells. They are also very toxic but they have an efficiency of about 25 percent. The raw material gallium exists only in small quantities on earth. Besides, GaAs is needed more urgently for semiconductor structural elements in the computer industry. So, that leaves us with silicon. The polycrystalline silicon cells are made by separation from silicon films upon a substrate consisting of metallurgical silicon. Here we get cells with an efficiency of about 10 percent.

Cells consisting of amorphous silicon have efficiencies of up to 5.5 percent. Because production is very cheap, we expect that amorphous cells will be used for purposes where space requirements play a subordinate role.

Semiconductor-Electrolyte Cells

Texas Instruments has developed a semiconductor-electrolyte cell where the electric energy, converted in the silicon spheres, is used for the electrolysis of hydrogen bromide. The components thus separated--that is, bromine and hydrogen--are transported in different tanks. In order to get electrical energy again, bromine and hydrogen are supplied to a fuel cell which, due to current removal, generates hydrogen bromide. The cycle is thus completed. The efficiency of these cells is 13 percent. One unsolved problem here involves the stability of the semiconductor photoelectrode against corrosion. The encapsulation of the cells is just as difficult.

Concentrator Systems

Because the efficiency of solar cells is improved as the radiation output increases, we are trying to cluster the solar rays by means of lenses and reflectors. In such systems, the use of solar cells with a high efficiency is quite worthwhile. One essential aspect for the success of these systems would be whether we can find cheap construction methods for the concentrator. It is a disadvantage here that these systems must be constantly watched and work efficiently only when the sky is clear.

Entirely different "concentrators" are being studied and developed by the Fraunhofer Society. These fluorescence panels can concentrate diffuse and direct sun rays. The stability of the panel plates is a problem that has not yet been solved.

Photovoltaic Systems

By means of series-connection and parallel-connection of individual solar cells, one can build up current supply systems with various voltages and outputs. The

solar cells to be sure have a long lifetime but they are very vulnerable to mechanical stress. They are therefore built into solar panels.

The ability of the solar panel to withstand rocks, sandstorms, snow, hail, and environmental pollution is the secret of the long operating lifetime of solar systems. The careful processing and selection of materials also are very important because the solar panel's efficiency depends on that. On the panel level it is about 10 percent when we use monocrystalline cells.

For the forward surface, Arco uses heat-treated safety glass which is as clear as water. This special-grade glass containing little iron allows more light to pass through than ordinary glass. The panel's reverse side consists of a tough metal sheet which is impermeable to moisture. Besides, Arco is using a special lamination process so that there is a rigid bond between the glass, the cells, and the rear surface. The individual layers are melted together with polyvinylbutyral.

Another important point is the mechanical processing. In the case of the solar panels made by Arco, we have a strong aluminum frame which is locked reciprocally at all four corners.

The Solarex solar panel consists of carrier plate made of glass-fiber-reinforced epoxy upon which the solar cells are mounted and then cast with special, glass-clear silicon synthetic substance. This synthetic silicon substance is UV-resistant and protects the solar cells against corrosion. In order to be able to withstand stronger mechanical stresses, the surfaces is provided with a glass or synthetic substance cover.

At this time, solar panels are being offered on the market with various outputs ranging from 0.4 w to 35 w. Solarex is now also delivering a 70 w module with cells made of semicrystalline silicon.

If we want to store the converted solar energy, we today usually employ a storage battery. Manufacturers in recent years have further extended the lifetime of these batteries. The Compound Company has developed storage batteries whose self-discharge is less than 3 percent per month. Batteries made by Saft, Sonnenschein, and Varta are likewise very reliable and have a long lifetime.

To make sure that the output supplied by the solar panel can also be used in an optimum fashion, the manufacturers recommend a charge regulator (Figure 15). The Chopper charge regulators have the highest efficiency.

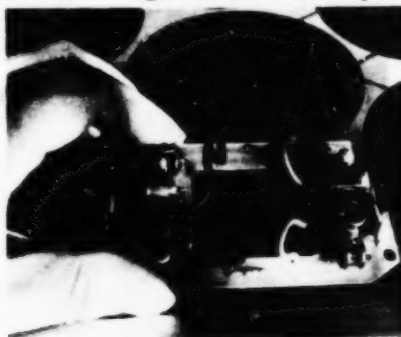


Figure 15. The charge regulator with SIPMOS output transistors can be placed in a 33 w panel (Factory photo by Siemens).

Siemens is even building an adaptation electronics unit which adjusts the resistance of the load circuit to the solar panel's characteristic curve and which thus provides for an optimum working point. Such circuits of course are very expensive so that they are worth the trouble only for systems in the kw range.

Deep-discharge protection is also needed for many uses and this might possibly be coupled with an alarm system. For protection against undercharging we also have load management systems which in case of undercharge danger first of all cut off the "luxury consumers." In other uses, for example, overload [overcharge] protection may be meaningful.

The field of adaptation electronics however is still in its infancy. The same is true of other system-engineering problems, for example, in the case of the VDE [Association of German Engineers] guidelines which cannot easily be converted for use with solar systems. According to Klaus Kaesen, Siemens is ahead of other companies in system engineering because Siemens can fall back on many years of experience in the field of rectifier equipment.

Dimensioning

The right dimensioning is a problem especially in the recreation sector but also in connection with the first export deals because many users are laymen electrotechnically speaking. Most suppliers of solar systems therefore ask the customer to fill out certain forms and the necessary size of the system is then figured out by computer.

But there are also companies, for example, Atec GmbH in Munich, which prefer manual calculation. The most important data are the available solar radiation and the profile of the required consumer output.

Summary

Photovoltaic current generation is still in its beginnings. In addition to technical and economic problems, there are also several political problems which must be solved.

Expectations and forecasts differ widely. We can only hope that solar energy will be used increasingly during the next several years because it does not entail the disadvantages of atomic energy and fossil fuels. Of course, the thermal use of solar energy will be considerably more important than the photovoltaic use.

The efforts of industry, above all on the part of the raw material producers, must be stepped up considerably if the forecasts by Siemens and the Department of Energy are to come true.

Photovoltaic current generation is a technique which can be handled in a very simple fashion and which is also suitable for the developing countries. The only trouble is that those countries might thus not become more independent of the industrial nations because the production of solar cells demands a high technical knowhow. Even the relatively long lifetime of 20 years does not change anything on that.

The question comes up again and again as to whether the energy expenditure necessary for cell production can be recovered in a reasonably short time through solar energy

conversion. This question indeed must be taken very seriously because, in any case, there will be a high energy requirement in the beginning as a result of the stepped-up use of solar cells. The "repayment rates" (energy payoff) under Central European weather conditions are between 2 and 3 years according to calculations by Professor Queisser.

Another problem connected with the industrial use of solar cells involves the environmental pollution. Here we might mention the aspect of landscape use and local heat supply. Because no cooling is necessary here, we do not have any water requirements either. Air pollution need be anticipated just as little as noise pollution. Of course, the use of "toxic" cells (GaAs and CdS) does constitute a threat because "cold" diffusion already can discharge toxic substances into the air. Traces of these highly toxic metals can then get into the soil due to rainwater.

Fluorescence Collector

By Professor Doctor A. Goetzberger and V. Wittner

The Institute of Applied Solid Body Physics of the Fraunhofer Society in Freiburg in recent years worked on novel collector systems which are particularly suitable for our latitudes; they can concentrate both directed and diffuse solar radiation. These research activities were taken over by the newly established solar energy systems study group.

The basic physical principle behind these collectors is the light conduction in transparent plates or fibers, such as it is being used today also in telephone and television engineering.

The starting material is a transparent glass or plexiglass plate which is doped with one or more fluorescent dyes. If environmental light I falls upon the plate, then it enters the collector and there it is absorbed by the dye and it is then emitted again in an isotropic fashion and shifted somewhat in a long-wave manner. This fluorescence light F_{1-3} is now conducted on the basis of the light conduction effect to the extent of about 75 percent in the plate and can leave the collector only along the edges. The concentration effect is based on the fact that we collect the light on large surfaces and that we can process it in a concentrated fashion along small edge surfaces.

In addition to the property to the effect that these collectors gather direct as well as diffuse sunlight, there is yet another property which distinguishes them from the conventional collectors: their spectral selectivity. Depending upon the choice of the dye or dyes, we absorb only a certain range of the incoming radiation. The advantage is that the outgoing concentrated light only comes out in a relatively small wavelength interval and that the absorber can be adapted to this wavelength in an optimum fashion. On the other hand, this selectivity means that a collector plate can process only a small part of the total incident energy. In practice we therefore will use a stack of different doped plates, each of which would absorb a spectral segment and would reflect concentrated light of differing wavelength which in the ideal case can be converted from differing, specifically adapted solar cells into current.

If we calculate such models theoretically, then, even assuming real dyestuff properties, we get total efficiencies of something like 10 percent. This magnitude is not very relevant so long as we know nothing about the concentration at which this efficiency is reached. Current experiments show that with a collector size of 1 m², we can achieve concentrations of 10-20. The biggest collectors investigated so far were squares with a dimension of 400 x 40 cm and a thickness of 3 mm. A single-stage collector absorbs about 20 percent of the incident energy. Its internal efficiency is about 40 percent so that about 80 percent of the incident energy will come out in a concentrated fashion at the edges. Depending upon the type of edge coverage [coating], this signifies a concentration factor of about 3-7, related to the total incident radiation flow. These relatively good figures however have so far been achieved only with dyestuffs which absorb in the short-wave spectral range and which fluoresce yellow to orange.

The development of new and better dyestuffs in the red and IR spectral range presently is the main point in the activities of the chemical industry in this field. An as yet unsolved problem involves the stability of collector plates. But definite progress was achieved in this field in recent times. The best figures currently give us an efficiency of 40 percent with one year of illumination out in the open.

5058

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ENERGY

EUROPE'S LARGEST COAL HYDROGENATION PLANT IN OPERATION

Plant in Bottrop

West Berlin DER TAGESSPIEGEL in German 9 Jul 81 p 1

[Text] With the push of a button yesterday, Minister President Rau of Nordrhein-Westfalen set Europe's largest coal hydrogenation plant into operation. The plant, in Bottrop, will produce some 140 metric tons of light oil and mineral oil daily, as well as gaseous products, from about 200 tons of bituminous coal. These products will be further processed for the fuel, heating and chemicals market at the Veba refinery in Geisenkirchen-Scholven. A special procedure was developed in Scholven for this purpose.

The Bottrop project, which was completed in 2 years, is expected to cost DM 420 million, including projected operating costs till 1983. The Land of Nordrhein-Westfalen had a 90-percent share in the total investment of DM 220 million. The plant has a total personnel of 215 employees. Yearly operation is expected to cost about DM 65 million.

Specifically, 70 tons of middle oil, 30 tons of light oil, 20 tons of liquefied gas and 20 tons of heating gas will be produced from the 200 tons of coal each work day. These will be further processed to heating oil, diesel fuel and carbureted fuel, as well as to synthetic gasoline. In the next few years the new Bottrop plant is expected to provide the necessary experience and data for planning, building and operating a large-scale plant, whose construction is envisioned to begin some time yet this decade. A definite site has not yet been found, however. According to a statement by Bund, the chairman of the board of directors of Ruhrkohle AG, gasoline from this plant would cost about DM 1.85 per liter, based on the current price situation for the use of German coal and on the same taxes. Coal refining plants have thus still not become fully competitive, but it is nonetheless certain that the gap will become increasingly smaller.

Forty-five years ago, on 7 July 1936, in a plant in Scholven, not far from the Bottrop site, gasoline was obtained from bituminous coal for the first time anywhere in the world. After further plants had gone into operation there, a yearly capacity of nearly 5 million tons was reached until 1940. That was some 25 percent of today's gasoline consumption in the FRG.

Minister President Rau said that the startup of the experimental plant was not the "starting gun for a large-scale, unlimited coal refining policy." It is, however, a bit of assurance for the future in that the FRG is mastering some new technology. All in all, coal liquefaction still has a long way to go before it becomes economically feasible, even if this way were to be facilitated by extensive government support. There is simply no way around a thrifty and rational use of energy. This is and shall remain the prime goal of the FRG's energy policy.

New Technology

Duesseldorf VDI NACHRICHTEN in German 17 Jul 81 p 1

[Excerpts] The plant in Bottrop works by a process of catalytic coal liquification which was developed from the earlier IG process as "new German technology."

The hydrogenation reactors are the core of the experimental plant. The hydrogenation reaction takes place at a pressure of 300 bar and a temperature of 475°C, with a throughput time of about 45 minutes. A mixture of liquid and gaseous hydrocarbons is produced. The raw produce consisting of liquid and gaseous hydrocarbons still contains small amounts of undissolved coal as well as nonreactable mineral impurities from the starting coal. After leaving the last hydrogenation reactor, this crude product must still be processed further in several steps.

Special consideration was given in the Bottrop project to make sure the plant would not pollute the environment. The chemical processes take place in closed systems, so that emissions are not to be expected. But all the other operations in the process--such as bringing in the coal on conveyor belts from the near-by coking plant and the drying and grinding of the coal--are also sealed off from the exterior. Flue gases and other exhausts are purified before being released into the air, so that the emissions are far below the permissible levels in the "technical manual for air." Approximately 20 percent of the total money investment was used for environmental-protective devices, including a protection against noise.

8838

CSO: 3102/367

TRANSPORTATION

AIRBUS NUMBER TWO IN WORLD

Bern TECHNISCHE RUNDSCHAU in German No 23, 2 Jun 81 pp 21, 23

[Excerpt] Airbus Industries (AI) is now second in annual sales; with its A300/310 family, it could build up a wide monopoly area in Europe, the Near East and Southeast Asia. Whether and when the program is expanded upward with the A330 and A340 (formerly the TA9 and TAl1) or downward with the A320 (formerly the SA-1 and -2) depends among other things mainly on the financial capabilities of the states and firms having an interest in AI.



In all, seven firms are involved in building the A300/310; Pratt & Whitney has recently joined. This engine manufacturer fitted out an A300 for the first time in 1980 and has been able to book various important orders for itself in the meantime, for instance the Swissair A310. (Lufthansa illustration)

8545

CSO: 3102/357

TRANSPORTATION

SWEDISH STATE RAILWAY STUDIES HYDROSTATIC DRIVE FOR TRAINS

West Berlin ZEITSCHRIFT FUER EISENBAHNWESEN UND VERKEHRSTECHNIK in German No 6, Jun 81 pp 184-185

[Article: "Hydrostatic Drive for Trains"]

[Text] Hydrostatic drive and braking are currently being tested within the Swedish State Railway (SJ) program for studying the use of new, operationally efficient power transmission systems. In this process, hydropumps and hydromotors supply energy to the wheels for acceleration and withhold it for braking. The basic principle of this method of power transmission is not new, but the control equipment fitted to the hydrodevice and the previously unattained efficiency of the hydraulic machines employed certainly are. The automatic control technology and the hydraulic components are spin-offs from Volvo Flygmotor's jet engine production.

Volvo Flygmotor AB (VFA) has been making high-quality hydraulic machines that are characterized by good efficiency since the beginning of the seventies. On the basis of these qualities, complete power transmissions were investigated as an alternative to existing systems in a Swedish State Railway study with the Imperial Department for Aid to Technical Development (STU). In this study, the system components of the power transmission of railroad vehicles were determined. System control capabilities were investigated first with an analog machine. Since the results were encouraging, practical tests were begun.

In April 1979, a contract was concluded between the Swedish State Railway and Volvo Flygmotor AB which provided for converting an X9 series train for hydrostatic drive and testing the system on the Swedish State Railway network to develop it further. STU financial support was a contract requirement.

In the summer of 1979, the drive unit was assembled, and in the winter of 1979/80, test driven on a motor test stand at the VFA together with the electronic control equipment. The main machine shop of the Swedish State Railway at Amal performed the necessary conversion and installation, and in May 1979, the vehicle was ready for testing.

Cooperative testing by the Swedish State Railway and VFA has been underway since May 1980 (figure 1).



Figure 1. Swedish State Railway Experimental X9 Series Railcar

Time planning and the cost calculations of the study were handled by a project group made up of three representatives each from the Swedish State Railway and VFA. This group has also continuously evaluated the project and is responsible for the final report to be submitted to the imperial department. VFA is responsible for detailed planning and implementation and is actively supported in this by the Swedish State Railway main machine shop in Amal.

Track trials were conducted by a Swedish State Railway engineer and two to four VFA engineers. The engineer had to coordinate with the other railroad traffic and was responsible for train operation and safety on board. VFA personnel conducted the tests and were responsible for the installed equipment as well as evaluation of the results.

The HP1 is a modified railcar of the four-part X9 type. An intermediate car was left out. Seats were removed from the middle car and the resulting free space used for two identical drive units. Through a transfer case, a diesel motor drives two hydraulic pumps with variable capacity. Through flexible hoses, each pump supplies a hydraulic motor with a constant amount of hydraulic oil. The motor drives the wheel axle through an axle-mounted gear transmission. In all, 4 of the 12 wheel axles on the train are driven this way. The other axles are not driven and run free.

All the seats and interior equipment in the front control car (with the sliding current contact) were left intact. The driver's cab was modified, however, to house the controls for the new power transmission system.

Some seats were removed in the rear control car to make room for the computer, electronic and recording equipment. The driver's cab was modified in the same way as in the front car.

When the train is standing still, the pumps pump no oil, but the drive motor, a diesel in this case, is in operation and drives the pumps. Through progressively

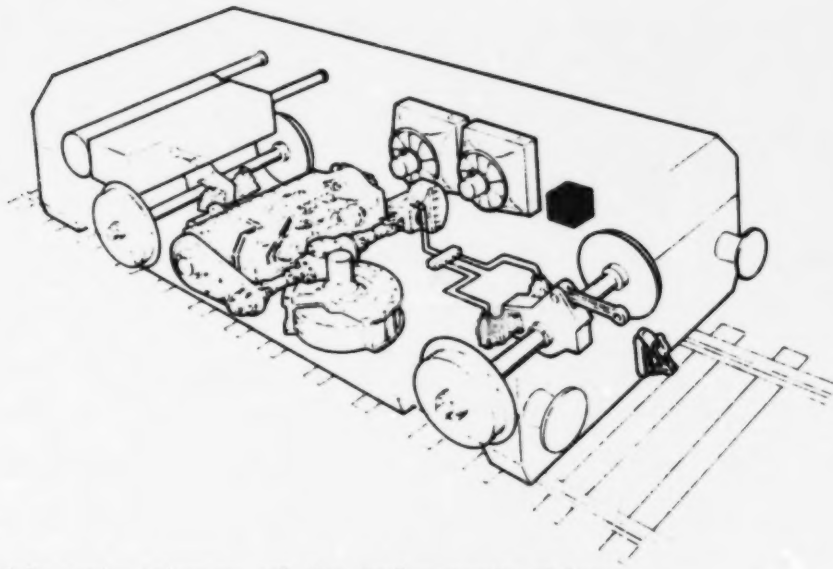


Figure 2. Schematic Diagram of the Hydrostatic Drive

increasing pump delivery from zero to full capacity, the train is set in motion and accelerated. It should be noted that in the process the pump rate is not changed, which opens attractive prospects for light, cheap and sturdy asynchronous motors as drive sources.

Travel direction is easily changed by reversing the oil flow. By reversing the pressure ratios in the system, the hydrostatic power transmission is used as a brake. When capacity is slowly decreased, the hydraulic motor at the double axle transmission operates as a pump driven by the rolling train and pressurizes the variable hydraulic pump with high-pressure oil. The latter is driven by the oil and operates as a motor. A retarder mounted on the diesel motor shaft converts the occurring brake energy into heat that is dissipated by cooling. This has produced a brake device that requires no action on the wheels whatsoever. This braking is effective over the entire drive area, wears out neither wheels nor brake shoes and operates very gently, smoothly and without annoyance for the passengers. The well-known difficulties due to skidding or locking wheels during acceleration or braking can be avoided. The hydrostatic power transmission requires a highly developed control system. Thanks to their experience in aeronautics, Volvo Flygmotor has the necessary know-how to develop such systems.

The main item in the control system is a microcomputer that contains the stored logic, records the engineer's actions, evaluates information on speed, pressure and rate among other things, and generates the required control signals for the execution of drive commands such as braking, acceleration, steady cruising, etc.

The engineer is provided with just one control panel to select a number of operating conditions:

- uniform acceleration to the desired speed, with gentle startup;
- maintenance of attained speed whereby the computer automatically carries out the adjustments for up- or down-grades;

- freewheeling of the train whereby the diesel has to compensate merely for the idling losses of the device;
- optional, selectable deceleration values using hydrostatics whereby good travelling comfort is maintained; and
- engagement of normal friction brakes, which are used however only as backups.

The computer samples each time the status of the drive governor, the speed and instantaneous performance of the diesel motor, delivery rating of the hydraulic pump, oil pressure of the hydraulic device, wheel speed as well as a number of monitoring signals. The computer interprets the sampled information and issues the appropriate control commands for the output regulator of the diesel motor, the capacity of the hydraulic pump and the retarder.

Aberrations, e.g. wheel skiddings, are detected and corrected in fractions of a second without engineer intervention. The computer is also capable of determining device malfunctions by location and magnitude and upon determination, automatically taking the necessary measures to counter serious malfunctions. The engineer is informed of a malfunction on a malfunction indicating panel.

The main purpose of the project is to develop and specify the control system for a hydrostatic power transmission, as well as to gather supporting data to develop components that are suitable for railroad service. Malfunction effects on the electronic units in the form of main voltage losses and encounters with Rc type thyristor locomotives were studied. No difficulties occurred with this. Maintenance of a constant speed, i.e. the capability of the control system to maintain a specified speed in mountainous terrain, was studied. As an example, it was stated that the train showed a maximum deviation of ± 2 km/h at 80 km/h.

Stable acceleration, a desirable feature to provide good passenger comfort, was realized with the HPI system. Stable deceleration means gentle and smooth braking of the train. Thanks to the capability of hydrostatically braking the entire drive range to zero without having to use the friction brakes, this feature was achieved.

Vibrations occurring in the drive unit and the two-axle bogie were recorded. This work was of use primarily in developing hydraulic motors for railroad service. Preliminary results indicate that the motors are exposed to no especially detrimental vibrations.

Much attention was paid to the slip/skid control system, i.e. the monitoring of the friction between the wheels and the track. The tests are aimed at finding ways to detect wheel skidding or locking during acceleration or braking in the beginning phase. The Swedish State Railway annually suffers extensive damage to wheels and rails, mainly through locked wheels during braking. Up to now, skidding or locking has occurred with hydraulic power transmission when pressure dropped rapidly. Since the rotating mass, compared with, for example, electric motors, is very small, a rapid and precise control system is required. A recently installed computer with expanded capabilities will further improve achievable results. A series model of the slippage detection system should be offered at a competitive price.

The HPl project was aimed primarily at developing a system for effective control and regulation of a hydrostatic power transmission.

Coming projects are aimed at designing installation sections suitable for production as well as research efforts focusing on reliability, durability and maintainability. In addition, the work installed on this particular vehicle has to be even better coordinated.

8545

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END

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West Europe Report

SCIENCE AND TECHNOLOGY

No. 72



FOREIGN BROADCAST INFORMATION SERVICE

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WEST EUROPE REPORT
SCIENCE AND TECHNOLOGY

No. 72

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CHEMICALS

GLASS-MAT-REINFORCED THERMOPLASTIC: STRONG, EASY TO WORK

Bern TECHNISCHE RUNDSCHAU in German 2 Jun 81 pp 33, 35

[Article by Engineer Martin Welz, Dr Erhard Siler, BASF [Baden Aniline and Soda Factory] Engineer Hartmut Schriever, Elastogran Lemfoerde: "Glass-Mat-Reinforced Thermoplastics (GMT)--Possibilities with a New Raw Material"; from the plastics laboratory of BASF, D-Ludwigshafen/BASF, Switzerland, AG [Incorporated], CH-8820 Waedenswil]

[Text] A synthetic sheet metal which, on the one hand, is as strong and rigid as steel and which can be processed as rapidly as sheet metal itself but which is also corrosion-proof, which is easily shapable and which is as light as synthetic material has always been a dream of processors and users. We believe that we have come closer to that goal in the form of GMT [glass-mat-reinforced thermoplastics].

Semifinished Product Manufacture

Glass-mat-reinforced thermoplastics are plate-like semifinished products made of thermoplastics with long glass fibers as reinforcement. One can use all easily-flowing thermoplastics as matrix material, such as PE, PP, PS, PA, PVC (Figure 1). Polypropylene is preferred here. In case of higher requirements in terms of heat-shaping resistance ($>130^{\circ}\text{C}$), polyamide is used as polymer matrix.

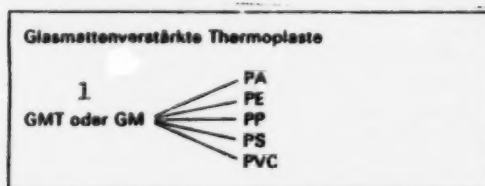


Figure 1. Glass-Fiber-Reinforced Thermoplastics. Key: 1--Or.

The long glass fibers used as reinforcement are present in the form of irregularly placed endless strands and, by virtue of their statistical, unoriented position, create a manifestation which is equal on all sides in the plane and adequate mobility during the shaping of the semifinished product. Endless glass fiber mats,

such as they are offered for the reinforcement of UP resins in manual laminating Prepreg methods, are of only limited use in thermoplastics reinforcement because of the fact that their bonding agents and their facings which are coordinated for UP resins. By means of specifically oriented optimization of glass mats and matrix materials, it is possible to make semifinished products with adjusted shaping and flow performance.

Semifinished product manufacturing is accomplished continually through the broad-slit extrusion of the thermoplastic material. The soaking of glass fibers with the polymer melt is so performed by means of special process engineering measures that a uniform distribution of the glass fibers is achieved in the plate along with intensive cross-linking with the polymers, without any noteworthy air inclusions [trapped air].

The production facility at the BASF affiliate Elastogran will soon turn out GMT semifinished products with a width of up to 1.4 m and thicknesses of about 1-6 mm. Normally, right-angle patterns are delivered but in thicknesses up to a maximum of 3 mm, GMT can also be wound up into coils and thus can be processed in a manner similar to sheet metal.

Various coatings can be applied during semifinished product manufacture, such as, for example, metal foils, synthetic leather, or also thermoplastic foil paper or decorator materials so that any additional lamination expenditure can be eliminated.

In contrast to hardenable semifinished products, such as SMC, GMT can also be stored in an unlimited manner as semifinished material.

Properties

The properties of GMT are determined by matrix material, glass fiber content and type, filler materials, and to a minor extent also by the processing conditions. The effect of the processing conditions on the finished part properties on the other hand is much greater and less well controllable in the case of systems which are cross-linked only during the shaping process. In the case of GMT, the semifinished product properties extensively correspond to those in the finished parts. This makes the design and layout of practice parts easier, starting with the measured property characteristics of the compound raw material.

In Figures 2 and 3 we compare our own standard products, a polypropylene, containing about 30 percent glass fibers, with steel plates and SMC (30 percent glass fibers).

Figure 2 represents the first column, the E-module. Steel plate is superior both to SMC and GMT regarding the pure material properties. But if we make parts of identical bending resistance from these three materials, then the GMT or SMC parts are only half as heavy as the parts made of steel (third column). The middle column tells us by how much thicker a GMT (3.7 x) or a SMC part (2.6 x) has to be than a corresponding steel part in order to attain the same rigidity.

In Figure 3, we have a comparison of the corresponding materials regarding strength. The first column represents the strength in N/mm^2 ; here, steel plate reveals between three and five times the value as compared to SMC and GMT. However,

related to the specific weight, the strength figures (tear distances) of GMT and steel plate are comparable and in the case of SMC they are even better.

Other important properties are illustrated in Table 1 as a function of the matrix material and in comparison to injection-molded trial bodies made of short-glass-fiber-reinforced thermoplastics.

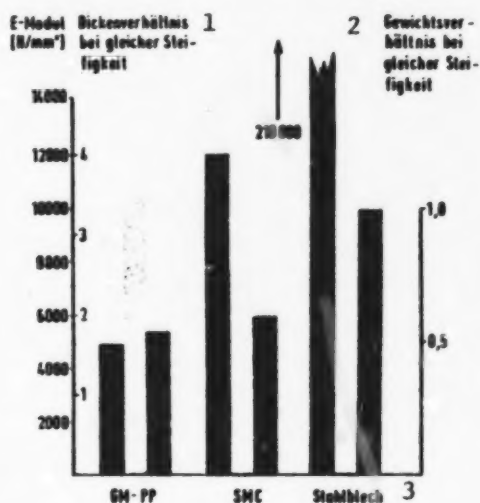


Figure 2. E-Module, Thickness and Weight Comparison of GM-PP With Respect to SMC and Steel Plate. Key: 1--Thickness ratio with same strength; 2--Weight ratio with same strength; 3--Steel plate.

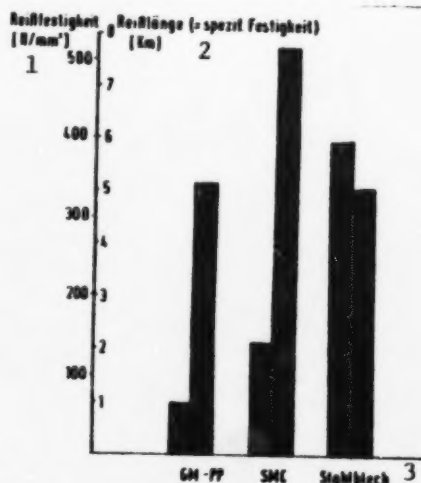


Figure 3. Tear Strength and Tear Distance GM-PP Compared to SMC and Steel Plate. Key: 1--Tear strength; 2--Tear distance (= specific strength); 3--Steel plate.

Table 1. Properties of GMT, Compared to Other Reinforced Synthetic Materials

Eigenschaft 1		2 Glasmatenverstärkte Thermoplaste (GMT)			SMC	3 GF-PA 6 Luftspricht (Ulramid B3W(G7) in Spritz- richtung 4 senkrecht zur Spritz- richtung 5	
		PP (*Novolen)	SAN (*Luran)	PA 6 (*Ulramid)			
Glasgehalt 6	15 (Gew.-%)	25-35	25-35	30	30	35	
	(Vol.-%)	11-17	12-19	16	15	19	
spezifisches Gewicht 7	(g/cm ³)	1,08-1,17	1,26-1,35	1,35	1,65	1,39	
Reißfestigkeit 8	(N/mm ²)	50-70	60-80	70-98	85	96	52
Biegefestigkeit 9	(N/mm ²)	60-100	105-125	70-160	160	150	-
Zug-E-Modul 10	(N/mm ²)	3900-5500	6800-8400	3800-6300	7100	7300	2760
Arbeitsaufnahme (Fläche 11 unter dem σ - ϵ -Diagramm)	(N/mm ²)	1,5	1,1	1,5-1,2	~1,2	5,4	-
therm. Längenausdehnungs- koeffizient α 12	(K ⁻¹)	45-25 · 10 ⁻⁶	30-20 · 10 ⁻⁶	-	20 · 10 ⁻⁶	20 · 10 ⁻⁶	-
dielektr. Verlustfaktor 13		0,002	0,014	0,065	0,05		0,19
tan δ bei 10° Hz							
max. Temperatur (kurzzeitig) 14	(°C)	130	95	150	180	180	

Key: 1--Property; 2--Glass-mat-reinforced thermoplastic; 3--Air-humid; 4--In injection device; 5--Perpendicularly to the direction of injection; 6--Glass content; 7--Specific weight; 8--Tear strength; 9--Bending strength; 10--Traction E-module; 11--Energy absorption (surface below σ - ϵ diagram); 12--Thermal longitudinal stretch coefficient α ; 13--Dielectric loss factor $\tan \delta$ at 10° Hz; 14--Maximum temperature (short-term); 15--Percent by weight.

As semifinished material, GMT is quasiisotropic in terms of the surface, that is to say, the properties are independent of the direction in terms of the plane. Due to the flow action during the further processing of the semifinished material, the glass fibers can be lined up as a function of the shape outline and the flow path and as a result of that we can get somewhat differing properties as compared to the semifinished material. If the material and the pattern are skillfully selected, this peculiarity can even be utilized in order more effectively to strengthen an unsymmetrically stressed shaped part in the main direction of stress.

The anisotropy of injected, short-fiber-reinforced thermoplastics is much more pronounced, as we can see in the last two columns in Table 1. The E-module and the strength here can be greater in the direction of injection, up to a factor of 3, than in a direction perpendicular thereto. This anisotropy which in most cases is undesirable (especially when we deal with large-surface injection-molded parts) is very difficult to influence for example through the selection of a different jet system. The measurements values on injection-molded samples, used below for comparison purposes, were always taken in the direction of injection and therefore give us excessively high measurement values in comparison to the quasiisotropic GMT.

Synthetic materials alter their properties under the influence of stress, temperature, time, and environmental media more than this is the case for example with steel plate.

Figure 4 shows the time creep strength of GMT as a function of the matrix material at various temperatures up to a stress time of 10,000 hours. It is interesting here to note the uniform level at high temperatures. The creep tendency of thermoplastics is thus heavily reduced by means of long-glass-fiber reinforcement.

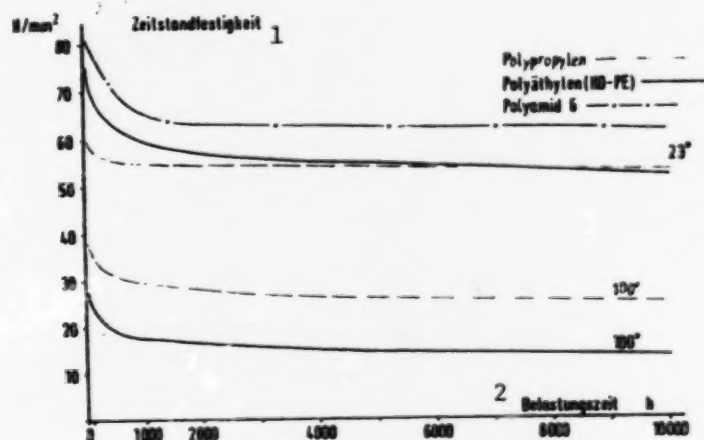


Figure 4. Time Creep Strength of Glass-Mat-Reinforced Thermoplastics. Key: 1--Time creep strength; 2--Stress time.

The dynamic properties of mat-reinforced thermoplastics are also very good. The samples are stressed in the alternating bending experiments with about 35 percent of the short-time creep strength at a frequency of 15 Hz more than 20 million times without any rupture (Figure 5). During this dynamic test, no serious temperature rise was observed, such as it otherwise leads to premature failure in the case of unreinforced or short-glass-fiber-reinforced samples.

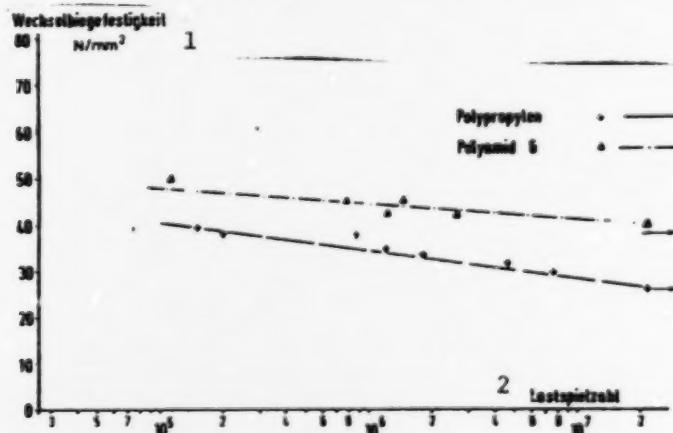


Figure 5. Alternating Bending Strength of GMT. Key: 1--Alternating bending strength; 2--Stress cycle criterion.

GMT on a base of tough thermoplastics, such as, for example, polyolefins or polyurethane, have a definitely benign rupture behavior because excessive local stress does not lead to catastrophic failure (separation fracture).

One of the serious disadvantages of synthetics is the temperature dependence of the properties. For example, the shock resistance of thermoplastics decreases as the temperature goes down. By means of reinforcement with long-fiber glass mats we can achieve extensive independence of the temperature (as we can see in Figure 6) along with a level which is increased five times compared to the short-glass-fiber reinforcements.

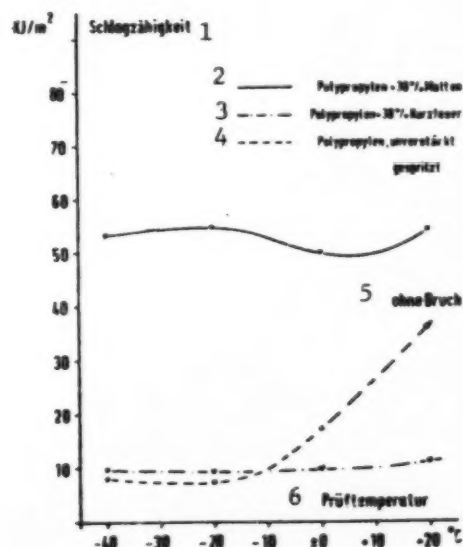


Figure 6. Shock Resistance as a Function of Testing Temperature. Key: 1--Shock resistance; 2--Polypropylene + 30% mats; 3--Polypropylene + 30% short fiber; 4--Polypropylene, unreinforced, injected; 5--No rupture; 6--Testing temperature.

The dependence of the E-module of various glass-mat-reinforced thermoplastics was measured in the bending-oscillation test and is illustrated in Figure 7. In designing load-bearing GMT parts, one must consider the drop of the E-module in the utility temperature range. Resistance to environmental media is important also to the lifetime and usefulness of mat-reinforced thermoplastics. During weathering in the Xeno test instrument, the E-module remains approximately constant while the tear strength, as shown in Figure 8, above all during the first 1,000 hours of weathering drops by as much as 40 percent; 1,000 hours in the Xeno test instrument corresponds to about 7,000 hours of summertime weathering.

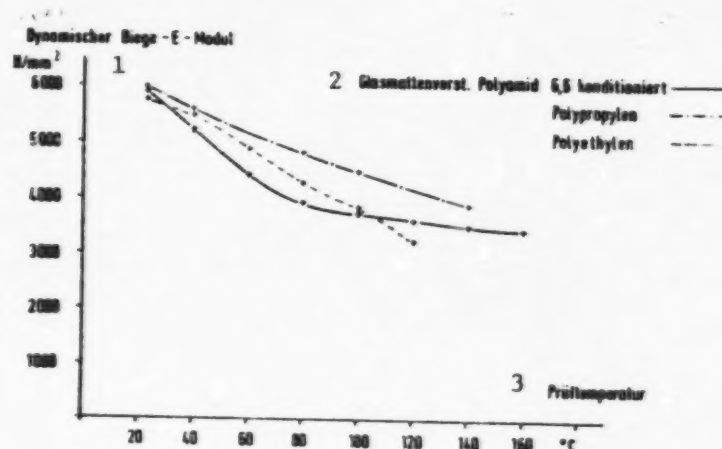


Figure 7. Dynamic E-Module as a Function of the Temperature. Key: 1--Dynamic bending E-module; 2--Glass-mat-reinforced polyamide, 6.6 conditioned; 3--Testing temperature.

Because GMT on a polyamide base is also supposed to be used in the combustion engine sector, we tested the resistance in oil at 120°C, in a water and glycol mixture at 90°C and in gasoline at 50°C (Figure 9).

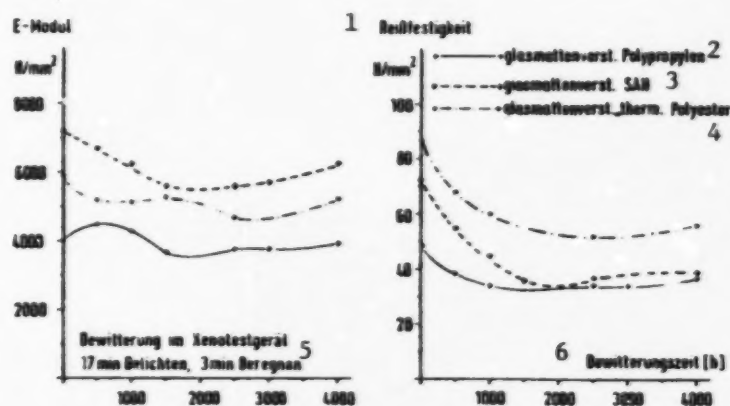


Figure 8. Properties of GMT as a Function of the Weathering Time. Key: 1--Tear strength; 2--Glass-mat-reinforced polypropylene; 3--Glass-mat-reinforced SAN; 4--Glass-mat-reinforced thermal polyester; 5--Weathering in Xeno test instrument, 17 minutes exposure, 3 minutes sprinkling; 6--Weathering time (hours).

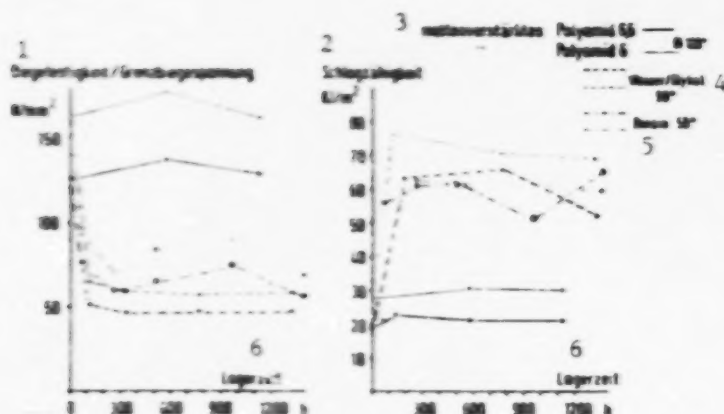


Figure 9. Properties of GM-PA in Various Media. Key: 1--Bending strength/boundary bending stress [tension]; 2--Shock resistance; 3--Mat-reinforced; 4--Water and glycol; 5--Gasoline; 6--Storage time.

Here the samples have quite different behavior. While the high bending strength and the relatively low shock strength of the dry samples remain preserved in hot oil, there is a change toward the viscous product in case of storage in glycol plus water and gasoline which is typical for polyamide also in a normal climate. The shock resistance increases almost three-fold while the bending strength or the boundary bending stress [tension] will decline to the same extent. After this adaptation to the environmental medium, which is completed in about 200 hours, the properties remain constant over a long period of time so that one can speak of a pronounced good resistance to hot oil, gasoline, and cooling water.

All glass-mat-reinforced thermoplastics--to the extent that they are not specially equipped--must be included in the category of "normally flammable" (construction material class B2 based on DIN [German Industrial Standard] 4102). By means of flame-retardant additives to the matrix material one can influence the fire or burning response to the extent that the test bodies can no longer be set afire or that the fire goes out by itself within a few seconds after ignition. Only when we use PVC as matrix material do we have a self-extinguishing piece of semi-finished material which, by means of relatively minor modifications, even reaches construction material class B1 (difficult to inflame).

Processing Technique

As in the case of steel plate, GMT, after it has been heated up externally, can be shaped in fast-flowing presses in cold tools, in the manner in which the principle is shown in Figure 10.

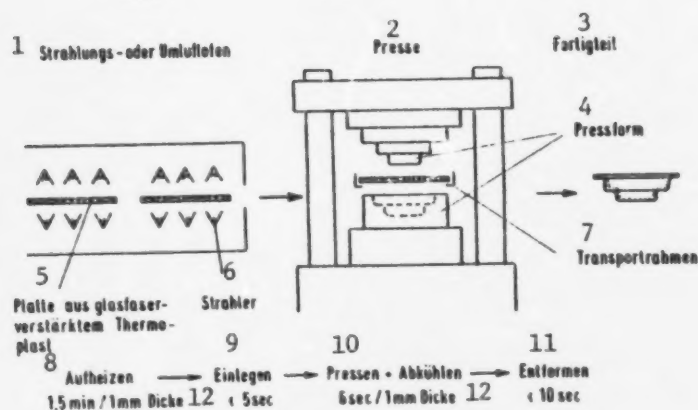


Figure 10. Principle of Deep-Drawing in Cold Molds. Key: 1--Radiation furnace or recirculated air furnace; 2--Press; 3--Finished part; 4--Pressing mold; 5--Plate made of glass-fiber-reinforced thermoplastic; 6--Heater; 7--Transport frame; 8--Heat-up; 9--Insertion; 10--Pressing plus cooling; 11--Removal from mold; 12--Thickness.

Here, in case of comparable dimensions, we can achieve shorter cycle times than during injection molding. GMT is cooled in the pressing mold only to a point below the solidification range whereas SMC gets its final character only in the (heated) mold through a cross-linking action. As a result of this, in the case of GMT, the pressing time is only 25-30 percent of the pressing time for SMC. To heat up the GMT, the furnace must be so large that the pressing time can determine the cadence, that is to say, if the heat-up time compared to the pressing time is about 10 times longer, then the furnace must be designed for ten blanks [patterns].

With the help of GMT, we can almost achieve the manufacturing times of corresponding steel plate parts. Above all it is the considerably shaped sheet metal parts which require more drawing and punching steps while only one pressing phase is necessary to make the GMT parts. Because we use GMT tools with dip edges, which do not require any subsequent cutting, it is possible to take a finished part from the mold (like sheet metal, GMT can be processed from the coil; together with the short cycle time, it is above all suitable for automatic large series production).

Medium pressed parts series however can also be made economically from GMT. Cast or milled tools made of aluminum or on a zinc base are suitable; the dip edges however should consist of steel here. Tool materials, such as hard woods and epoxyresin are suitable for prototypes and small preliminary series where optimum cycle time and mold accuracy are not important.

The heating-up can be accomplished in recycled air furnaces, in the bright or dark radiation field or between heating plates. The heating time is determined by the low heat conductivity of the synthetic materials and the limited temperature stressability particularly in case of an oxygen-containing environment. The blanks are heated up to 40-60°C above the melting range of the matrix material. Transport into the mold for example is accomplished by means of a guided frame or a wire mesh [conveyor] belt. After the deposit of the blank or blanks in the mold, the

latter must be closed very quickly--possibly within 5 seconds up to the point of pressure buildup to prevent the material from cooling off prior to the final molding.

The pressure necessary to achieve good mold filling and a neat surface depends on the speed of closing and the pressure buildup time, on the mold outline, the mold temperature, and the mold material. It is between 2 and 250 bar ($2 \cdot 10^5$ and $25 \cdot 10^6$ Pa). In case of metal mold, we must use pressures from 50 bar ($5 \cdot 10^6$ Pa) to 250 ($25 \cdot 10^6$ Pa); in case of wooden and synthetic resin molds, which do not allow the preheated blank to cool off as quickly, it suffices to have $2(2 \cdot 10^5)$ to 20 bar ($2 \cdot 10^6$ Pa).

The practical engineering properties of GMT are determined primarily by the matrix material while the processing properties (especially the flow performance) are determined by the optimum coordination between matrix material and reinforcement material. In terms of pressing technique we differentiate two processing techniques whose advantages and disadvantages are listed in Table 2, below.

Table 2.

Shaping	Flow-pressing
Insertion technique	
Mold-covering	Smaller blanks
Single-layer	Multi-layer
Advantages:	
No problems with insertion technique, easily automated	No waste
Mold parts quasiisotropic, no flow seams	Complex finished-part geometry possible
Wood or epoxyresin molds for small series	(Ribs, thickenings)
Adequate, lining possible	No dip-edge wear and tear
Disadvantages	
Dip-edge wear and tear; 5-15% waste (usable)	Exact positioning of blanks necessary, automatic insertion expensive, anisotropy
Ribs and thickenings can be made only to a limited extent	due to flow orientation, weak points due to flow seams, metal molds required for necessary high pressure, lining difficult

The impression given by Table 2 is somewhat deceptive: the advantages of shaping seem to predominate. In point of fact however flow-pressing is credited with better chances above all because the great advantage compared to sheet metal--that is to say the ability to make ribs and to make different wall thickness--can be utilized in this method.

The following two figures show experimental molded parts made of GMT: the box in Figure 11 has been shaped and its lined with a red surface foil. In Figure 12 we have a geometrically complicated molded part with various ribs, thickenings, and recesses, made according to the extrusion-pressing method.

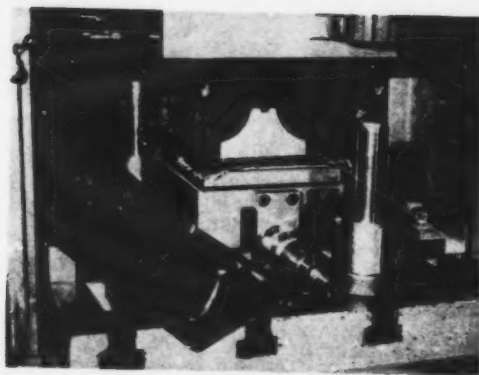


Figure 11. Experimental Molded Part.



Figure 12. Complicated Molded Part Made According to Extrusion-Press Method.

It order to keep the orientation as small as possible during extrusion pressing, it is necessary to optimize the size, number, and position of the blanks in terms of the mold. We check on the fiber position here best by means of x-ray pictures which give us clear images also in case of dyed and filled matrix materials.

Figure 13 shows such a picture of intrusion-pressed little cups of which the one on the right was pressed together from small blanks and therefore reveals strong orientations of the fibers in the areas around the edges.

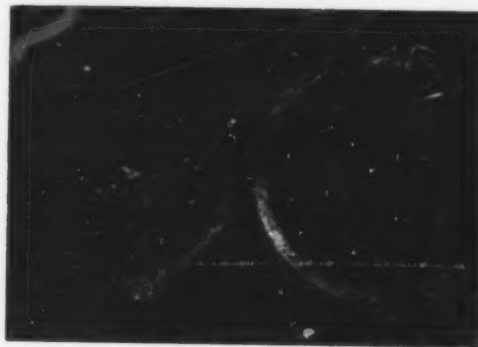


Figure 13. X-Ray Image of Extrusion-Pressed Little Cups.

The processing shrinkage, which must already be taken into consideration during tool-making, depends on the glass-fiber content and the filler-material content, on the matrix type and above all on the tool temperature; it is between 0.2 and 0.5 percent.

GMT waste from semifinished product manufacturing and from cutting or waste parts can be reclaimed by means of grinding in granulate grain size and can be turned into valuable raw materials which can be reused for injection molding or extrusion.

Connecting Technique and Lining Possibilities

All connecting [bonding] techniques that can be employed with thermoplastics can be used in connection with GMT--although with one restriction: the flow of force through the long glass fibers must not be interrupted. Butt-weld seams on the other hand make no sense here; they transmit only 10-20 percent of the plate material's strength.

GMT can be bonded with itself or also with other compatible thermoplastics by means of ultrasound, hot-gas, heating-element, and friction welding. The thickness kink through the overlap (as we can see in Figure 14) can be extensively avoided under favorable conditions. The attainable quality grades for seam welding are 0.95 for ultrasound and heat-element welding; a maximum of 0.6 was achieved with ultrasound point welding.



Figure 14. Overlap Welding Without Major Thickness Kink.

Metal bushings, to be embedded in GMT, and self-cutting screws are suitable for soluble connections with ultrasound.

GMT can be coated with synthetic foil, metal foil, or textiles either during semifinished product manufacturing or during the pressing of the molded part. For metal foils and for synthetic foils not compatible with the matrix material, we need adhesion agents for adequate bonding. Such adhesion agents have been developed. They can either be applied in advance upon the foil through extrusion or solution coating or they can be applied during semifinished product manufacturing through the coextrusion of the adhesive between GMT and the foil.

By means of metal foils, we can restrict the shapability of GMT, especially by means of hard [foils], such as, for example, noble steel whereas synthetic foils and textiles can be used also in connection with heavily shaped parts (Figure 15).



Figure 15. GMT Coated With Metal Foil.

Glass-mat-reinforced thermoplastic plates are very well suited for the manufacture of sandwich plates and parts as covering layers. As core material we can use PUR hard and soft foam, polystyrene, polyethylene, and other foam, as well as wood, honeycomb cores of aluminum or paper and other light-weight construction materials.

In most material combinations, we do not need an additional adhesive between the core and the covering layers. The connection is achieved by heating up the covering layers beyond the melting temperature of the matrix materials and by pressing with the cold core material. In the case of otherwise incompatible material combinations, one can likewise achieve good adhesion through mechanical anchoring of the melt in the celled or rough core material. Adhesion-improving, low-melting intermediate layers are required in addition only rarely.

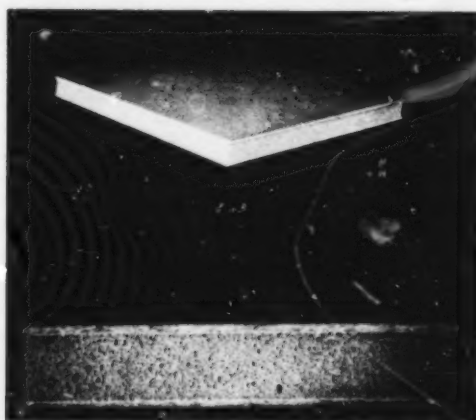


Figure 16. Sandwich Made of Glass-Mat-Reinforced Polyethylene With PUR Hard Foam.

GMT is basically lacquerable; some thermoplastics, such as, for example, the polyolefins, of course, require either a primer, on which a commercially available synthetic resin lacquer can then be applied, or a special lacquer to which adhesion-promoting additives have been added. Surface quality and in the case of lacquered

sheet metal, such as it is required for automobile outside parts, can presently be achieved in the case of GMT only through additional work processes, such as priming [with the spatula] and grinding.

Practical Uses

Glass-mat-reinforced thermoplastics are suitable for large-surface, load-bearing, or self-supporting parts. The following are currently being tested for practical engineering applications: valve lids, oil pans, carriers for bumpers and linings which are then refoamed, gear and spare-tire covers. Possible applications for example are seat shells, car-body parts in the nonvisual area, such as spoilers, engine covers, and partitions.

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ENERGY

SOLAR PROJECT AT ALMERIA NEARS COMPLETION

Zurich CHEMISCHE RUNDSCHAU in German 25 May 81 pp 3, 5

[Article by Hans Fricker, head of the New Technologies department of Sulzer Brothers Inc., Winterthur: "Project 'Almeria:' Energy From the Sun"]

[Text] In the search for new sources of energy the use of solar energy is being intensely studied and promoted all over the world. In this connection the production of electricity is also of prime importance, in addition to the use of solar energy for heating homes and water.

At Almeria in southern Spain, a project simultaneously involving three experimental power plants is underway, one facility with 1,000 kW capacity built by a Spanish consortium and two with 500 kW each built by international groups within the framework of the "small solar power system" (SSPS) development of the International Energy Agency (IEA).

Sulzer participates as a major supplier to one of the facilities, in the so-called central receiver system (CRS).

CRS Facility at Almeria

The contract for the design, construction and commissioning of this facility was awarded to the firm of Interatom GmbH of Bergisch-Gladbach by the "operating agent," the German Research and Development Institute for Air and Space Travel (DFVLR), Cologne. The FRG, the United States, Spain, Italy, Belgium, Switzerland, Austria, Sweden and Greece are involved financially and through industrial deliveries in the construction of the facility, which is to begin operation in 1981.

Ninety-three mirrors (heliostats) steered by a computer reflect the sunlight at all times of the day and year into the opening of a combustion chamber (receiver) mounted on a 43 meter high tower. There, the cooling medium, liquid sodium, is heated from 270 C to 530 C, after which it flows to the hot storage tank installed on the ground. As needed, sodium can be circulated out of the tank through the steam generator into a cold storage tank and from there back to be reheated in the receiver. The steam created in the steam generator expands in a steam engine; the mechanical energy created there drives the 500 kW generator, which produces electric power.

The reasons for the choice of sodium as the cooling medium on the one hand lie in the outstanding heat transfer properties and on the other in the good storage capability. The high heat conductivity allows for the construction of relatively small equipment, whereby heat losses, in particular in the receiver, may be kept small. Simple energy storage through hot sodium is very important in particular for solar energy facilities, because the plant may be operated at peak capacity for up to 2 hours during cloudy weather, and even at night a certain amount of power production can be guaranteed. However, the sodium imposes considerable demands on the components.

Two of the most important parts of the plant are supplied by Sulzer: the receiver and the steam generator with the pressure relief system.

Receiver

Its most important technical data are:

Thermal capacity	2.7 MW
Mass flow rate	7.34 kg/s
Temperature at inlet	270 C
at outlet	530 C
Maximum thermal flux	63 W/cm ²

The core of the receiver is a pipe cluster, which consists of curved pipes with a 38 mm diameter and a 1.5 mm wall thickness, spaced 43 mm horizontally and forming a 3.6 meter high wall. These pipes are connected to each other by curved sections into six pipe coils, in which the flow is from the bottom to the top. The wall of pipes is supported by one stationary and three movable beams in such a way that the pipes at different temperatures can expand without great tension. This is an essential prerequisite for operation with rapidly changing capacity, so that when weather conditions change the isolation, for example during brief overcast periods, this can be controlled without complicated operational procedures.

Behind the wall of pipes is a wall of ceramic tiles. This wall collects the radiation which passes around the piped, about 5 percent, and also serves as a heat accumulator.

Around the wall of pipes a 6 meter high insulated box with a semicircular outline protects against excessive heat loss. Its opening of 3.4 by 3.5 meters can be tightly closed by means of two electrically operated sliding doors in order to further reduce heat losses during shady periods.

A multitude of new kinds of problems had to be resolved by means of construction, calculations and experiments. The experience gained in this way will lead to simplifications and cost reductions in future construction of similar equipment, which is of the greatest importance for the success of such solar energy facilities.

Steam Generator

Based on Sulzer's extensive experience in building high-capacity steam generators for nuclear plants, a very simple compact steam generator with a coil pipe construction was designed and built.

The data are:

Thermal capacity	2.2 MW
Sodium side:	
Mass flow rate	6.76 kg/s
Temperature at inlet	525 C
at outlet	269 C
Water/steam side:	
Mass flow rate	0.87 kg/s
Temperature at inlet	193 C
at outlet	500 C
Pressure	100 bar

The feed water which flows in from below is distributed equally to three heating surface pipes. The pipes are wound in a helical coil with a 544 mm diameter and are heated by a counter current of sodium flowing from top to bottom. The steam which is created leaves the steam generator at the top and then reaches the steam engine. A pressure relief system also guarantees the safety of the plant in the unlikely event of the bursting of a steam pipe. Just as in the receiver, the pipe mountings are constructed so that rapid changes in temperature do not lead to dangerous tensions.

Second Generation Competitive With Oil?

The experience gained in the design and construction of these components is considerable. With the operational experiences which will be gained in 1981, Sulzer will be in a position to offer even more sophisticated equipment for second-generation facilities. In so doing it will be very important, as was already mentioned, to achieve the highest efficiency with the smallest possible expenditure.

The present facilities for production of electricity through solar energy are still relatively expensive, and the power produced with it is competitive only in exceptional cases. If the predictions for the cost development of "solar power" in comparison with "oil power" are correct, solar energy could become competitive with oil in the foreseeable future. This does not, of course, hold true in comparison with large coal-fired or even nuclear facilities. However, if one takes into account that solar energy is attractive mainly to regions near the equator, where for example large nuclear plants scarcely come into question because the infrastructure is lacking, solar power plants may indeed be given a chance for success.

11949

CSO: 3102/366

ENERGY

GERMAN-ARGENTINE EXPERIMENT: VERTICAL-ROTOR WIND ENGINE

West Berlin DER TAGESSPIEGEL in German 4 Jul 81 p 12

[Article by Peter Raabe: "Wind Motor With Braking Flaps--Vertical Rotor Instead of Propeller--German-Argentine Experiment]

[Text] Wind mills and the recreated modern wind energy plants, respectively, must not necessarily be equipped with a horizontally rotating axis according to rule. Neither do they always have to feature the regular propellers. GROWIAN (being the German abbreviation for the "Large Wind Energy Plant" by Messerschmitt-Boelkow-Blohm under construction in Northern Germany) proves that a one-blade propeller will do.

A total of more than 40 wind motors designed to make power supply independent of oil are being supported by the Federal Ministry for Research and Technology. One of the most interesting projects is the wind rotor of the so-called Darrieus design which was designed by Dornier. Instead of a conventional propeller, it has a vertical rotor which makes it independent of the wind direction. In a recently commenced large-scale project in Patagonia, Argentina, investigations are under way to determine the extent of energy obtainable from the wind by means of this unusual system. German and Argentine experts have intentionally selected Comodoro Rivadavia, located 1,600 kilometers south of Buenos Aires on the Atlantic coast, as the site, because this is one of the areas on this earth with the most wind.

Famous Flettner Rotor

In former times, rotors were utilized as suppliers of energy in nautical and aeronautical engineering experiments; in either field, it was a matter of propulsion and lift energy. The Flettner rotor became particularly famous. Its inventor (Flettner) utilized the physical fact that by turning of a cylindrical roll, pressure will result on the one side, and low pressure, or suction, on the other side. These are effects which are normally caused by a ship's sail and a wing profile and thus contribute to a forward motion and generation of lift, respectively.

The wind rotor according to the Darrieus principle, however, may be compared to the Flettner rotor only with qualifications, because it features additional "wings" besides the vertical axis coupled with the power generator: a total of 3, which are arranged around the 15-m rotating axis in a crescent manner. These aluminum blades, however, are most decisive because they effect the wind motor rotation.

As Dr Joachim Dreyer, Dornier System, states, "We have given these "wings" a profile also encountered in aeroengineering, which is symmetrical and has particularly favorable aerodynamic efficiency." (As Dornier is involved in the construction of aircraft, this adaptation of aerodynamic principles is no surprise). The blades are extra-ordinarily narrow, due to the design of this wind motor as a so-called "fast runner." A wind motor with wider wings or one with a larger number of blades would turn slower and thus reduce the overall efficiency of the plant.

Movement by Means of Wind Collectors

Even starting the wind motor is comparable to starting the engines of an aircraft: the rotor does not start until it reaches a certain minimum speed. In order to reach this speed, the rotor system is sped up by means of the so-called Savonius rotors. These "wind collectors" are located at the top and bottom of the rotating axis and start with a wind velocity of four meters per second. Everything else is then done by the "wings." At approx. 80 revolutions per minute, corresponding to a wind velocity of eleven meters per second, a nominal output of 20 kW is attained.

Tested in 'Many a Storm'

The plant built for windy Patagonia had to withstand many storms as a model in the wind channel. Later, a model which was smaller compared to the now existing original was placed in the Black Forest and subsequently on an island in the sand banks of Pellworm. Here it was a matter of refining the system technically to the point that it could withstand wind velocities of up to 220 km/h. An emergency safety device is modelled after the aeroplane: Dr Dreyer states, "We installed braking flaps on the rotor blades which automatically extend by centrifugal force when the velocity becomes critical. Thus, the maximum permissible number of revolutions, 100 rev/min, will never be exceeded." If the braking flaps fail, an additional disc brake will be activated as a second braking device.

In spite of its considerable size—total height 17.5 m, 12-m diameter of the rotor system—the plant requires very little maintenance. In practice only the two rotating bearings located at the top and bottom of the axis require lubrication. The initial plan is to change the oil required for the purpose only twice a year.

Designed by aircraft designers: This wind motor built by Dornier System is independent of the direction of the wind due to its vertical rotating axis. The narrow rotor blades tested in the wind channel have optimum aerodynamic efficiency. Drum-like wind collectors at the top and bottom of the rotating axis serve as "starters." The plant incorporates simple instead of sophisticated mechanical parts, and its maintenance requirements are extremely low.

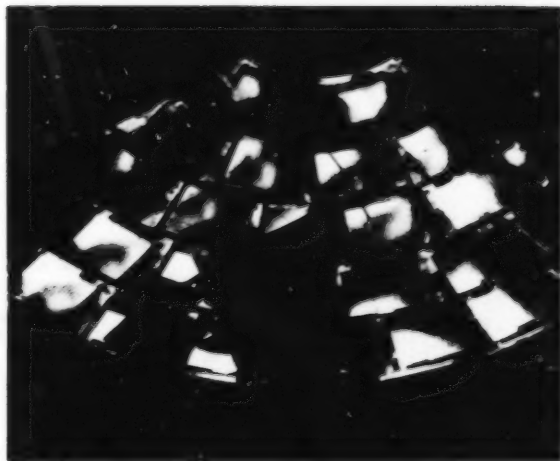
ENERGY

BRIEFS

TRACKING SOLAR GENERATOR—At the Hanover Fair, AEG-Telefunken introduced a solar generator developed in cooperation with MAN, which converts solar energy directly into electrical energy and automatically tracks the position of the sun while rotating around two axes. The 40 m² solar power station has a 1.5 kW output with full sun radiation. Due to the constant vertical impact of the sun's rays, the energy supply is 20 to 40 percent above that of a nontracking solar generator of the same size, depending on the geographical location of the site. In addition, the manufacturer has developed a procedure to reduce reflection. Each silicon cell is optically refined by means of an application by vaporization process. Our photograph shows the extraction of the cells from the vaporization carousel.

[Text] [Wuerzburg ELEKTROTECHNIK in German 11 May 81 p 5] 9544

CSO: 3102/342



INDUSTRIAL TECHNOLOGY

DEFINITION PHASE COMPLETE FOR CITROEN'S FLEXIBLE WORKSHOP

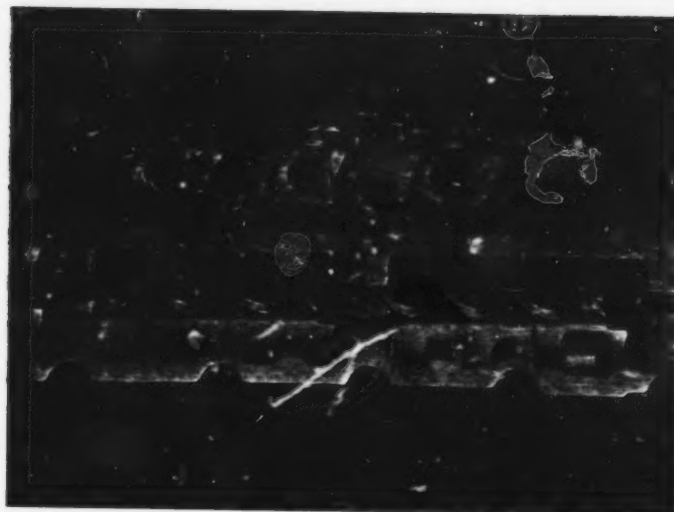
Paris INDUSTRIES & TECHNIQUES in French 10 Jun 81 pp 13-14

[Article by Alain Perez: "Flexible Shop: Citroen Raises the Curtain"]

[Text] The unit will be operational in mid-May 1983. It is a lighthouse project suited to the needs of a PMI (small and medium-sized industry) general machine shop.

The Citroen flexible workshop has now been totally defined. The final specifications were turned over to Codis on 9 June, and the only important decision still pending concerns the selection of major production equipment suppliers. The unit will also be a demonstration showcase; it is now a foregone conclusion that for equal technology, French suppliers will be the favorites in the selections that the PSA affiliate will have to make before September.

This flexible module will theoretically become operational in mid-1983 at Citroen's mechanical construction division in Meudon. The overall installation designed to machine prototype parts for the various automotive studies departments of the PSA group includes five sectors. The fabrication workshop proper, where the following will be installed: three identical five-axis palletizable machining centers, a numerical control measuring machine, an automatic robotized washing machine, and an inspection area for doubtful parts and carrier maintenance. In addition, the workshop will also include an area for palletizing and balancing of foundry castings, which is a manual station in its present configuration; a tool shop, which is itself a second flexible system designed to manage an inventory of 500-600 tools, with its own metrology and sharpening annexes; five self-propelled carriers guided with wires embedded into the floor, which perform tool transfer and transfer of rough parts, or parts in the process of being machined; and finally, a minicomputer for real-time management of all machining operations and distribution of parts and tools. The total investment amounts to 36 MF (million francs), of which one-quarter is being carried by Codis. Many suppliers are still competing at this time. For the machining centers: Grafenstaden, Forest, Cincinnati, and Kerney Trecker. On this point, the French firms will have to challenge a competition already familiarized with five-axis centers, which are made necessary by the complexity of machining operations (essentially gearbox cases and engine blocks). For the guided carriers: Saxby, Seiv, and CFC. For the cleaning machine (which will integrate a washing robot into the conventional station), the choice will be made among Mabor,

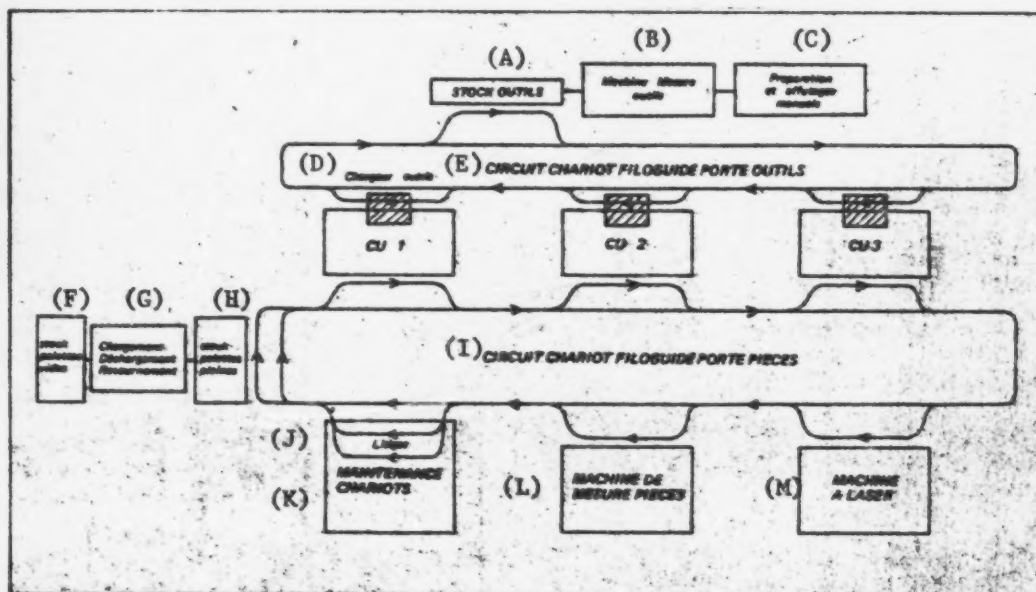


Meudon will be in charge of fabricating complex prototype parts. The goal will be to reduce fabrication delays by a factor of three.

Carrier, and Haffroy. A complete programming of the cleaning cycle is planned for this non-standard equipment, including all slant borings. The wash jet is directed by a six-axis robot, the part remaining fixed. The robot carrying the pressurized (200 bars) washing head will probably be supplied by Acma, Aoip, or Asea.

The choice is even broader for the measuring machine: Leitz, Seiv, Sagem, Zeiss, and Ferranti are still in the running. The numerical controls will be supplied by Num SA if the French manufacturer can meet the delays. As for the information tool, it will come from Sems, Cii-HB, Intertechnique, or Siemens. There are no outstanding features for this standard item, which will be the first to be ordered as of July. Language and programming will be perfected by Automatique Industrielle, which is general contractor for the project and was founded last October. Its capital is divided among PSA (40 percent), the Societe Generale (through its affiliate SG2, 40 percent), Rhone Poulenc (10 percent), and Puk (10 percent). Citroen is the job contractor for construction. In practice, the only manual intervention will take place at the beginning of the cycle for identification and initial clamping of the part on its pallet, or during the cycle if reprocessing is needed. Automatic balancing would have required shape-recognition devices, an approach which is considered too complicated at this time. In addition to the machining cycle, the program initiated by the code contains the washing program, metrology, and unloading. The clamped and coded part is then directed according to computer instructions to one of the machining centers by one of the self-propelled carriers. Each center has a tool loader with some 100 tools, allowing the successive fabrication of two parts, the one in process and the one on stand-by.

Machining times vary from 10 to 90 minutes. Successive tool feeding is achieved during idle time by the same carriers from the central store. Machine use is maximized by mixing various types of parts, for machining times longer than six minutes per cycle. Transfer time between two machines is on the order of one



Structure of the flexible shop. There are actually two complementary shops. Tool management and traffic on one side, fabrication, transfer, and inspection of parts on the other. (Documents Citroen)

- Key:
- (A) Tool stock
 - (B) Tool-measuring machine
 - (C) Manual preparation and sharpening
 - (D) Tool loader
 - (E) Guided tool-carrier circuit
 - (F) Empty pallet stock
 - (G) Loading, unloading, reprocessing
 - (H) Loaded pallet stock
 - (I) Guided part-carrier circuit
 - (J) Rejects
 - (K) Carrier maintenance
 - (L) Part-measuring machine
 - (M) Laser machine

minute, but a part will not necessarily be completely machined in a single center. The changing time for a tool from shaving to shaving is less than 30 seconds. Plans are to eventually connect the measuring machine and the machining centers: the exchange of information between the two installations should provide a real-time compensation for tool wear. The high unit-cost of parts (runs of 1 to 100) led to an early decision to salvage doubtful parts as much as possible. In this case, the part is reexamined in a special area and manually inspected. In favorable cases it can be reintroduced into the fabrication circuit after modification of the process. The process is rigid (one process for one part) and is performed in CFAO. The carrier circuit is a closed loop without intersections. Traffic is resolved on the principle of waiting lines (buffer zone at the center of the shop). Operation of the overall installation was simulated on the Amdahl V5 computer at Quai de Javel.

The profitability of the system is maximized for runs of 20 to 150 parts, corresponding to the requirements of a PMI for general machine shop work. In the case of PSA, the system affords a three-fold reduction of fabrication lead times for prototype car components, which are currently of the order of 50 days with standard equipment. In the case of absolute priority (replacement or modification of a component for a vehicle undergoing testing), loading is immediate. A complicated part can therefore be produced in less than two days. All the machines are equipped with self-diagnostics and fail-safe systems (interlocking in case of tool breakage). Breakdown of one of the centers reduces the shop capacity by one-third.

In final analysis, the association of all these techniques multiplies the cutting time by four (60 percent compared to less than 15 percent in a conventional shop). Three people are in charge of fabrication: one for loading and palletizing, one for reprocessing, and one for supervision. Three others take care of the tool shop. The unit will operate with three shifts.

The final objective of Citroen and Automatique Industrielle is to establish a totally integrated and autonomous shop. The plans are to eventually add preventive tool-breakage detection. Statistical methods will be used at first. After 1983, sensors will be integrated into the tool heads, to continuously measure motor power variations.

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INDUSTRIAL TECHNOLOGY

LATEST TECHNOLOGIES APPLIED AT CHARLEVILLE FOUNDRY

Paris INDUSTRIES & TECHNIQUES in French 10 Jun 81 pp 37-41

[Article by Jean Deflacieliere: "The Superlative Foundry is French"]

[Text] Better quality parts at significantly lower prices. Personnel escapes the inferno of conventional foundries. Information processing, robotics, microprocessors.

In 1972, Citroen had assigned to Guy Latchague the task of creating a clean, competitive foundry to eventually replace the one in Clichy. He has succeeded so well, that today it would be quite difficult to find a more modern one. As he modestly says: "They envy us." His Italian and Japanese competitors want to buy the special, one of a kind, machinery invented by the engineering department of the company. His secret? Tenacity: "You must know what you want, know how to explain it, and know how to wait until the technicians find the answer."

The enterprise supplies most of the company's plants. It also supplies the parts used jointly by Peugeot, Renault, and Volvo. The ferrous section (sand process) produces rotating parts in grey cast iron: brake drums and disks, engine flywheels. But especially safety components in GS iron (with spheroidal graphite) such as steering pins, suspension arms, camshafts, and so on. Aluminum alloys are used for chill-casting engine heads, gearbox cases, and pistons.

A plant of this size, able to deliver over 300 tons of cast iron and 120 tons of aluminum daily, cannot be improvised overnight. Its design and construction cannot be anything but gradual, especially since there was no question of abruptly cutting back Clichy's activity, and since this investment of over one billion francs had to become profitable as soon as possible.

Since the start-up of the first line in April 1974, the foundry has steadily rounded out its production facilities and increased its manpower, which currently numbers about 1300 people. Changes have been so rapid that visitors from headquarters no longer recognize the equipment. For Guy Latchague, this continual flux constitutes the major difficulty of his enterprise: "To establish a plant which can remain up-to-date for about 30 years while technology evolves very fast." It was therefore necessary to make use of what was available at each stage while planning later adaptations to higher performance equipment. A technologic cross-section thus discloses the successive stages of progress: electromechanical relays in a first phase, followed by 40 programmable automated units in the second one, ending with the arrival of microprocessors in the most recent installation.



Every day, 160 tons of cast iron and 33 tons of aluminum are brought in the receiving ladle by travelling crane, after the furnace is tipped by push-button control.

From the very beginning, information processing played a crucial role in defining the project. In any case it would have been inconceivable to add it after the fact: it comes into play in real-time in all aspects of the plant's activity, from supporting local sequential commands, to performing the most varied management tasks, and including such process controls as metal formulation or cast moldings. This hierarchic system relies on two mainframes and 10 process computers. The data is obtained from 6000 points and 400 sensors which measure weight, temperatures, as well as water, electricity, and compressed air flows; 139 terminals and printers are scattered throughout the enterprise. One employee monitors the general installations from the central control room. In case of mishap, which is immediately displayed on the console, the employee has 1000 remote controls with which to start a given dryer or compressor, or to stop a machine, or else to decouple one section of the foundry. If necessary, the employee can also alert central maintenance, or one of the maintenance teams which have been decentralized for speedier intervention.

A logbook records all changes in conditions, wherever they may occur in the plant. Maintenance uses it to trace deviations in machine cycles with respect to the norm. Imperceptible to the naked eye but scrupulously recorded by the computer, microstops in the line can signal potential breakdowns. These observations are of considerable value: they provide the tangible foundations for preventive maintenance.

This computation capability also makes it possible to direct the start or unloading of electrical machinery, so as not to exceed the ceiling authorized by the EdF (Electricite de France) contract. It is easier to understand the importance of this management when one realizes that each of the three arc-furnaces consumes as much as a 3500-employee assembly and machining plant. The foundry's total kilowatt consumption equals that of the city of Charleville.



Along a 492-meter conveyor, the molds travel at constant speed in front of the ladles whose load is electronically measured.

The automatic devices have become too numerous for anyone to keep track of. Robots ladle out the aluminum in the chill-molds, while others manipulate molten clusters or place cores in position. Special machines form cores, remove clusters, deburr, or control. Stripping and tumbling drums, 16 meters long and 4 meters in diameter, separate the parts from the sand, clean them, and lower their temperature from 600 to 60 degrees.

Iron casting is one of the most spectacular of the applications of this process. A few seconds are enough to change tools even though they weigh nearly one ton. The mixture of sand, clay, coal dust, and water falls on the chassis halves mounted on the steel molds. The machine scrapes and tamps. A conveyor brings the mold halves to assembly stations. Formerly, all of this was accomplished manually with hoists, whereas today, one technician watches the operation unfold on the indicators, screen, and printer of the "control tower." Alain Beaujot, responsible for methods, is equally proud of the automatic casting of ferrous metals. Three hundred molds constantly move along the line. The central computers determine which of them is to be filled; the casting carrier is indexed before that mold and releases the required quantity of metal.

Automation Has Altered the Rules of the Game

The most notable feature of the aluminum alloy area is the distribution of the sand needed to form cores. Two buckets are loaded under the mixers and move to the coring machines on a monorail over 100 meters-long.

After casting, robots move the parts to the cluster removal and core extraction station, and then to finishing. Next comes the major innovation which consists of recovering the sand, after the resins which lent it cohesion are incinerated. The savings amount to about 120 tons per day, not even counting the expense of mandatory transportation to controlled disposal sites.

Another spinoff of data processing is that automatic quality control changes the rules of the game. Some fifty parameters determine whether a part is well cast: metallurgy, clay, and coal dust content of the sand, granulometry, humidity, and so on. Until now, one managed for the best, playing it by ear, for the simple reason that a chemical analysis of the casting meant a three-day wait.

At Charleville, casters take a sample from the furnace and send it to the laboratory by pneumatic tube. Determined by spectrometry and calculated on the computer, the composition of the metal is displayed a few minutes later on the terminal in their shop, with indications of the fine adjustments that need to be made. The sands are themselves continually checked by probes inserted in mixers which handle two tons every four minutes.

The plant has no less than five laboratories (chemistry, sand, non-destructive testing, and so on), which employ 25 people and analyze samples. The fabricators perform their own unit tests of safety components, using Foucault currents and magnetoscopy. All these efforts pay off. Casting now produces parts which at one time had to be forged. GS iron no longer requires thermal treatment, and Alain Beaujot is now amused by the installation designed to reprocess excessive or inadequate hardnesses: "We don't use it much."

Automation is reflected in cost reductions of 20-30 percent. An equivalent production with conventional means would have required three times as much manpower. For the workers, modernization means above all, radically changed living and working conditions. Mr Lernoux, personnel director, would not like to see the plant represented "in an idyllic light, like a paradise." But we are far from the inferno of traditional foundries. This is evidenced by the rate of absenteeism (less than 9 percent), which is comparable to that of the company as a whole, and is also less than one-half the rate for foundries in the Ardennes region; additional evidence lies in the exceptionally low personnel turnover (2-3 percent).

Silicosis has of course disappeared and safety is scrupulously watched: "When he enters the plant, the worker does not have to wonder whether he will come out in one piece." A specialized engineer studies each new machine, and its placement in service requires his approval. As a result, the accident rate is 13 instead of the usual 100 (per 100,000 work-hours).

Here you will certainly never see what you still see in other recent foundries: men standing on gratings, breaking up sprues with 1.2-meter sledges. Nor will you find casters vibrating powdered coal and sand to fill the molds. Nor manual handling of 150-kg casting ladles. Nor workers bent over inside a coring machine. Robotics has freed the workers from the demanding and dangerous operations which brought them in direct contact with the heat released by metals, or with dust and noise. The machine now endures the hardship. Everything has been done to keep the worker away from harmful environments. Arc-furnaces still operate at 1400 degrees and more than 100 decibels, but employees no longer have to work near them in Charleville. The operator remains some distance away in his air-conditioned control room. In any case, all the shops are kept dust-free and heated by a system which circulates one million cubic meters of air per hour. The noisiest areas have also been carefully sound-proofed: the arc-furnaces are surrounded by concrete shells and removable covers, and the tumblers are isolated in booths.

Men are no longer required to run or use their muscles, but to operate and control. These enhanced tasks are entrusted to more highly qualified workers: 40 percent of them are professionals, and one-third of these are assigned to maintenance, which is becoming a vital function because of robotics. Women (20 percent of the work force) are also finding opportunities: there are as many of them in the shops as in the offices. Naturally, all this requires training efforts to match the novelty of the technologies that are used.

Doubled Aluminum Capability, Improved Casting Finishing

Management attaches great importance to employee participation in the enterprise's productivity and quality objectives. In order to increase worker responsibility it integrates more and more of the control functions into production. Innovation is encouraged by a suggestion system and by forming work teams for specific problems. The personnel thus generates nearly 2000 improvement suggestions per year. Citroen also insisted on demonstrating that industry does not necessarily mean pollution, as long as there is a determination to maintain it clean. The buildings are surrounded by green lawns and flowering trees. The only trace of activity is a thin water vapor plume above one of the stacks. Other nuisances have been radically eliminated. Arc-furnace fumes and dusts are sucked into filtering installations. The air in the shops is also passed through purifiers before venting. A settling pond treats the waste water and tests it before release. And finally, casting scraps, sprues, saw shavings, and rejects are recycled by melting.

Despite the profusion of state of the art technology in every nook and cranny, the Charleville foundry will not finalize its equipment for some time to come. There are already plans to double the aluminum capability, to refine casting finishing, and to create 700 jobs between now and 1985. Another major first is also being planned: automatic delivery of cores from stock to molds, under the control of central data processors, using carriers guided by wires embedded in the floor.

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INDUSTRIAL TECHNOLOGY

COMPANY WILL MARKET SMALL, MODULAR FLEXIBLE WORKSHOP

Paris L'USINE NOUVELLE in French 30 Jul 81 p 47

[Article by Daniel Coue: "Flexible Workshops Also for Assembly"]

[Text] The concept of flexible workshops is not reserved exclusively for fabrication. Assembly operations are also included. Especially for short runs. The equipment will be inexpensive and well adapted to PME (Small and Medium-Size Enterprises) needs.

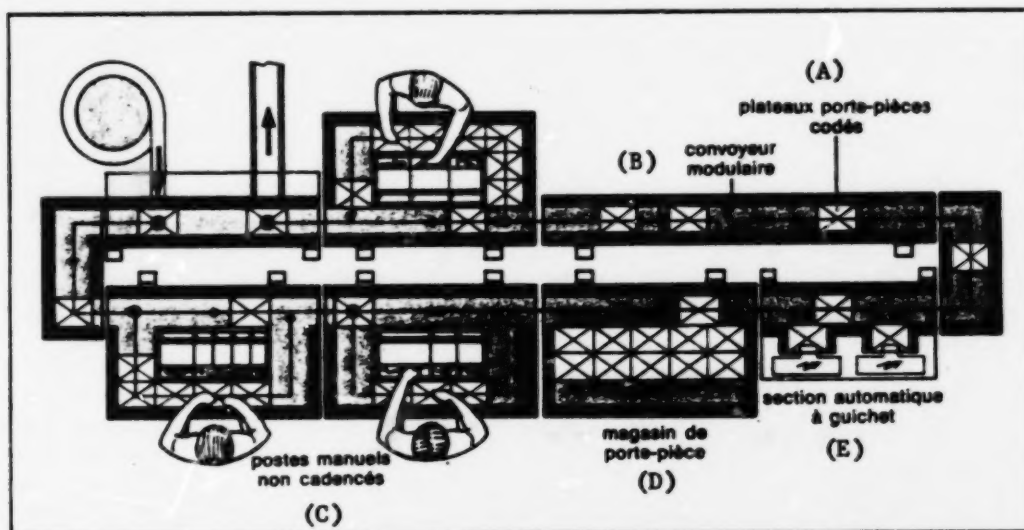
At first sight, the prototype unveiled by Prodel Automation is just another assembly machine; and yet it portends the first flexible workshop ever built in Europe.

In fact, it is flexible in every sense of the word. This concept will make it possible not only to assemble several different products in short and medium-size runs, using the same equipment, but with time, will also enable a great many changes in product design or production size. All of it at the cost of easy and inexpensive transformations or extensions of the installation.

"Actually, since its construction is based on standard modules, our flexible assembly workshop will be reusable, and even negotiable, when the assembly or assemblies being manufactured are outdated," points out Jean-Paul Delaveau, marketing director of Prodel. "It is the universe of rational assembly, applied to limited runs. And with prospects for enormous productivity increases."

In particular, this should fit the needs and means of PME's. "Actually, that is why we relied on rather simple technologies and components, as well as on easy operation," adds Jean-Paul Delaveau.

Each basic module has its own electric motor drives, and is first of all a portion of an endless conveyor operating on the principle of free transfer of part-carrying trays. Each tray has a cam memory coded for the order of operations to be performed on the part. Depending on the stage of assembly, the tray recognizes the station at which it must stop. It is even possible to take into account the loading of each station.



An configuration example of the flexible assembly workshop. Each module, manual or automatic, is a portion of an endless conveyor operating on the principle of free transfer of part-carrier trays.

- Key: (A) Coded part-carrier trays
 (B) Modular conveyor
 (C) Untimed manual stations
 (D) Part-carrier storage
 (E) Automatic section with slot

Introduction at the Beginning of 1982

The manual modules have a by-pass from the main flow, in which several trays can accumulate. They are then advanced by a pedal pressed by the operator. This flexibility is also found in the automatic modules, which can be equipped with slot systems which do not open to the conveyor tray during the operation time. Moreover, buffer storages are provided; they are distributed around the traffic flow, to allow the storage of trays and the regulation of traffic.

Thanks to this modular structure, it will be possible for instance, to upgrade the installation toward progressive task automation, without complete redesign of the basic production equipment. Therefore, the solution adopted and applied almost immediately, will always conform to the optimum conditions compatible with the production rate. And of course, the launching of a new product, similar or not to the first, will not necessarily imply the installation of a new line: a few new modules will be sufficient. This will result in space and manpower savings, and in a substantial reduction of initial investments, since the price of a module, whether manual or automatic, should not exceed 28,000 francs.

Introduced as a result of a development contract, and partly financed by Codis (Steering Committee for Development of Strategic Industries)--the support will be continued by Anvar (National Agency for Implementation of Research)--this study has already been well received by industry: Telemecanique expects to adopt this system for assembling contactors, Salomon for ski assembly, and Black and Decker, SEB, and Verto (Valeo Group) for complete assembly of various devices. The first placement in operation will occur at the beginning of 1982.

Until then, the operating principle will be studied further. "In any case we will retain the solutions currently adopted, and the pneumatic servos in particular, because they are still the least expensive," predicts Jean-Paul Delaveau. "But to improve flexibility and versatility we will have to have recourse to other processes." For this, Prodel has just started--with the University of Compiègne, located very near the Carlepont plant--a study on the use of bar-codes. The tray markers will be read by optical readers located upstream of each traffic node, and the entire system will be managed by a programmable automatic device. "It will be most sophisticated," concludes Jean-Paul Delaveau. "But even at the present state of things, we believe that we can meet a good many needs."

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INDUSTRIAL TECHNOLOGY

AUTOMATED PRODUCTION OF NUCLEAR-RELATED CATALYTIC ELEMENTS

Paris L'USINE NOUVELLE in French 30 Jul 81 pp 43-45

[Article by Jacques Antoine: "Rapid Production and Quality Are Compatible"]

[Text] Decouple operations by interposing dynamic buffer storage, place several machines in parallel per operation, integrate real-time control at each station; these have been Sfec's (Company for Catalytic Element Fabrication) solutions for the extremely rapid production of a complex and fragile product. A model of integral automation.

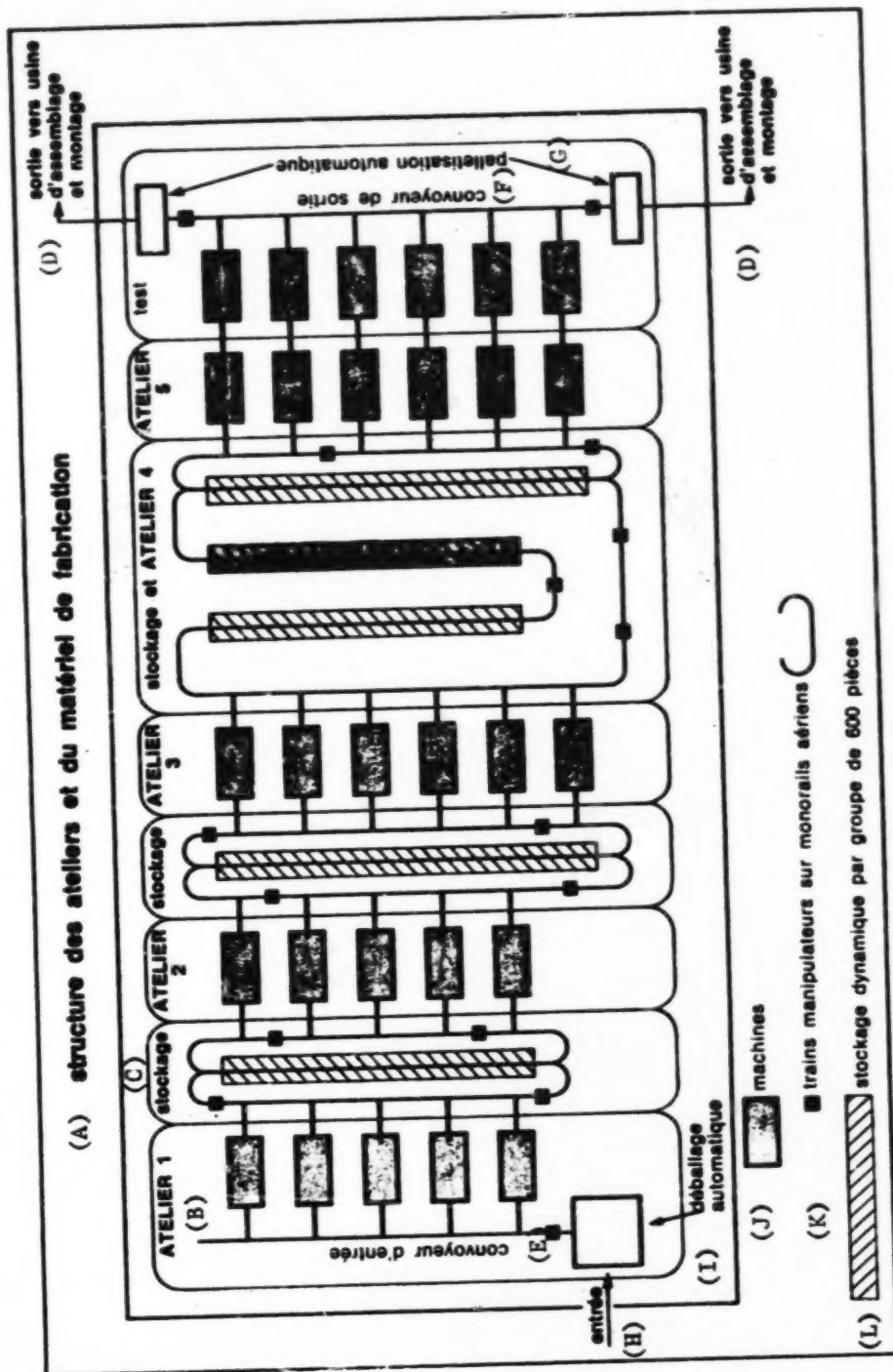
The problem: manufacture more than 100 million units of a very fragile part in the limited time of five years; unique, this part is intended for a single customer whose quality requirements are very demanding. The nuclear industry does not cut corners! Question: how to produce it?

This was the problem handed to Sfec, when it was asked to supply diffusion barriers designed for the Eurodif uranium enrichment plant. At Tricastin-Pierrelatte, the solutions adopted and used since 1976 are practiced in two plants; one for step manufacturing (sequence of operations), the other for installation and assembly. The two plants are entirely automated: the parts are never touched by human hands.

What are the various fabrication operations? Protected by the "national defense" secret classification, their description is out of the question here, although L'USINE NOUVELLE has had the privilege of learning the entire process. However, the exemplary nature of this automation--entirely French it should be added--deserves our attention, even though it concerns a one-product and one-customer industry. The situation may be quite unusual but not the constraints: these can be of a socioeconomic nature (cost reduction and manpower problems), or technical (process reliability and product quality).

30,000 Logic Input-Outputs

The first constraint is that the product--a ceramic tube two centimeters in diameter and about one meter long--is fragile. Manual handling results in a lot of breakage. Moreover, any grease and dust contamination is prohibited. "We have automated the operations as well as the handling between work stations," explains Rene Rouviere, technical director. The second constraint is that the required production rate is



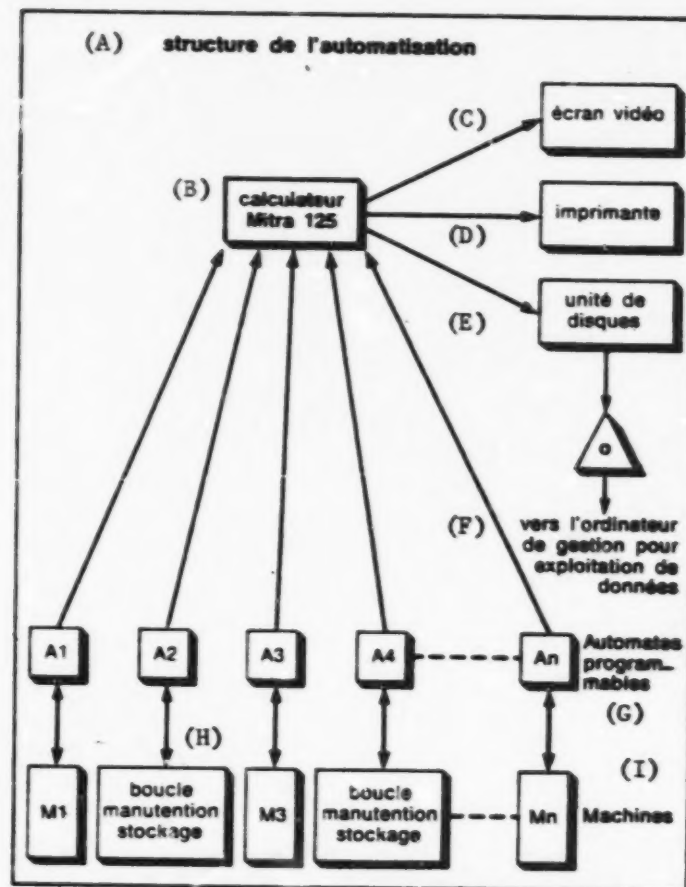
With a dynamic buffer storage between each operation, parts in process take second place. In order to maintain very high production rates, the loading of work stations has priority. Any one machine in a shop can thus supply any other machine in the next shop. The keystone of the system is a network of programmable controllers supervised by a computer.

- Key: (A) Structure of shops and manufacturing equipment
(B) Atelier = shop
(C) Stockage = storage
(D) To installation and assembly plant
(E) Input conveyor
(F) Output conveyor
(G) Automatic palletization
(H) Input
(I) Automatic uncrating
(J) Machines
(K) Handling trains on overhead monorails
(L) Dynamic storage in groups of 600 parts

infernal: of the order of two to three parts per second! "When needed, we have put in service several machines per operation." Which, we should add, must be adequately supplied. "We have adopted shops specialized by operations, with the machines in parallel. Each of these independent modules is supplied from a dynamic buffer stock—with the first-in parts being the first ones out—which acts as an interface between two successive phases of the process." The third constraint is that the fabrication must have a large number of systematic unit verifications, whose results must be immediate in view of the production rate. It is out of the question in fact, to complete a part damaged during an operation. "We have integrated automatic controls at each station. A defective tube is rejected on the spot. On some machines, the tooling involved is also removed for checking."

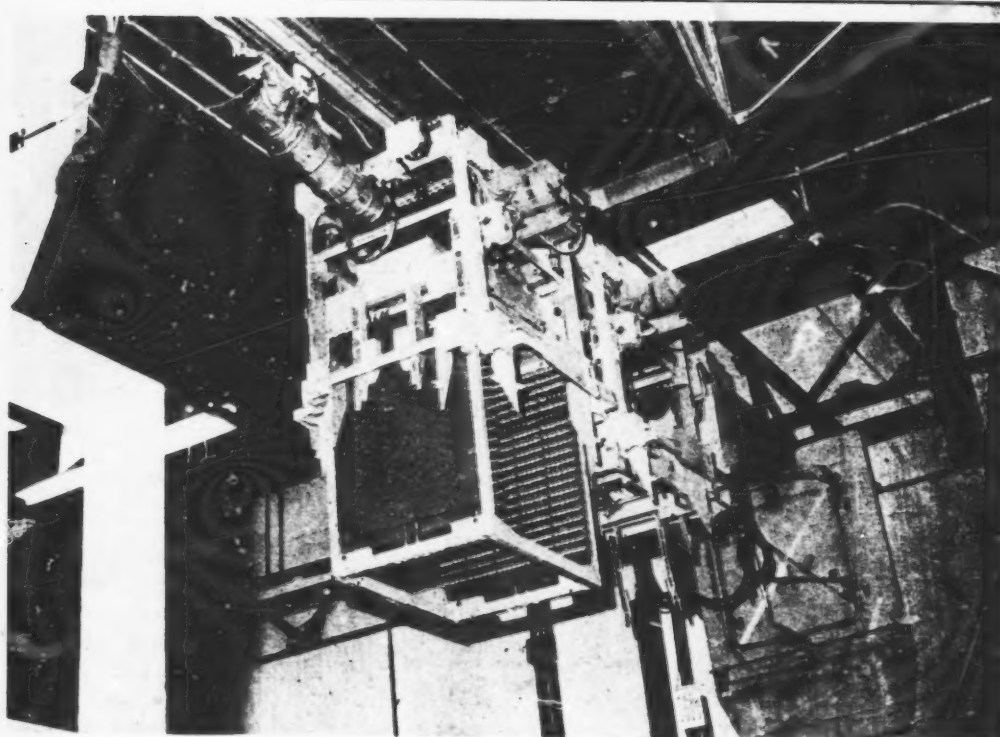
The operations being sequential, the control of the process has been turned over to programmable controllers (sequencers); there are about 35 of them in the manufacturing plant, and they are connected to a computer. The assembly plant is not far behind with some thirty controllers. All in all, this represents some 30,000 logic input-outputs. Probably a record in France! "We have decentralized the controls for operational safety reasons," explains Guy Palmier, one of the automation specialists at Sfec. "Only the supervision has been entrusted to the central computer. We did not want to run the risk of a general breakdown." To which, Rene Rouviere adds: "The most delicate aspect of automation is the start-up and rate build-up of the machines."

Like surgeons, dressed in white coats, let us enter the first plant. The atmosphere is perfectly controlled. Cleanliness requirements are such that the machines are designed to operate without lubrication, and the exhaust of pneumatic cylinders is collected to avoid oil mists. The rough tubes, manufactured by Euroceral and Ceraver, arrive in racks enclosed in containers. Automation begins from the moment they arrive. They are opened on a special machine, and an overhead conveyor supplies the five machines of Shop No 1 with racks. Each machine is directed by an controller with an average of 400-500 input-outputs (CIT-Alcatel and a few CGE Alsthom), with photoelectric or capacitance detectors verifying the presence of the parts. According to Charles Oliveira, responsible for the controller department at Sfec, the list of of these measurements at work stations located in various shops is a long one. "To control the presence of a metallic deposit, the speed of wire feed, permeability, temperatures, mechanical resistance, water tightness, and so on." This drastic quality control goes beyond the rejection of defective parts; at some stations, a loop is formed between the control and adjustment of machines upstream from it.



The Mitra 125 central computer has no command function, and merely receives information from the controllers; this provides a real-time picture of the plant's operation.

- Key:
- (A) Automation structure
 - (B) Mitra 125 computer
 - (C) Video screen
 - (D) Printer
 - (E) Disc unit
 - (F) To management computer for data analysis
 - (G) Programmable controllers
 - (H) Handling and storage loop
 - (I) Machines

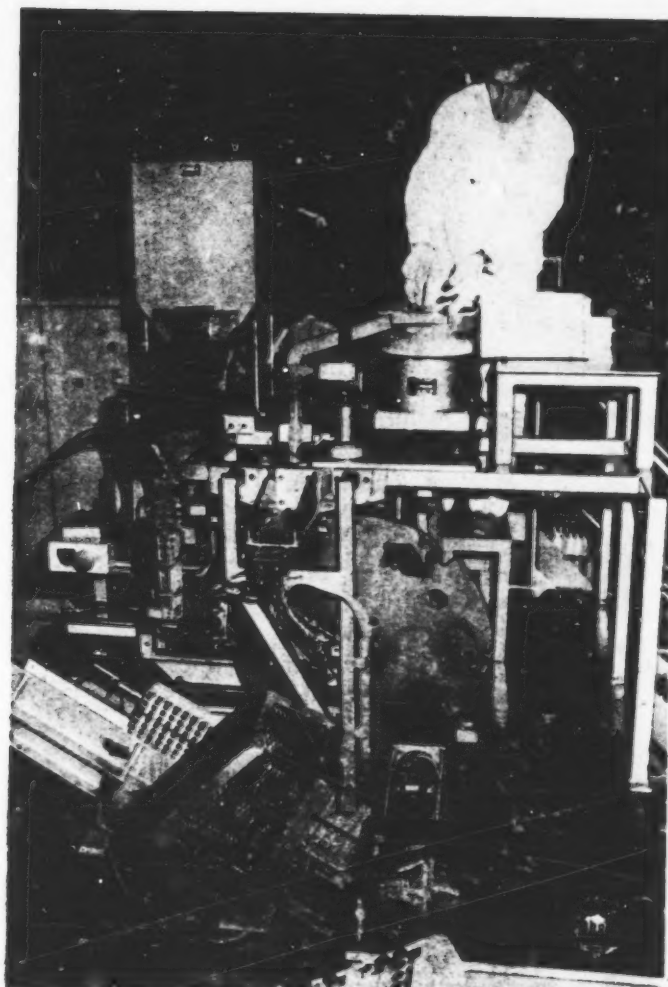


Depending on the upstream and downstream information, a handling controller on the floor orders this handling train, moving on a monorail and controlled by a small on-board controller, to supply the next available machine. In front, empty, the system which supports the racks for 600 parts.

All Programs Can Be Manually Overridden

Each machine controller directs the steps and supply of its station, supervises product control (performance of measurements), tallies part loading and unloading (data transmitted to the central computer), assists the operator--or rather the attendant--(message posting), detects defects and informs the computer for maintenance diagnostics. "All the programs can be disconnected and run manually by the operator if problems have to be corrected," says Jean-Pierre Crouzet, head of the plant.

Part of the information is directed to a management controller associated with each handling line. Thus, if a machine runs short of parts, this handling controller directs the conveyor to immediately supply racks. The same principle prevails in successive shops, separated by a dynamic buffer storage. Depending on the upstream and downstream information, the handling controller commands a handling train, running on an overhead monorail and controlled by a small on-board controller, to service the requesting station. "The system reduces waiting time to a minimum," says Jean-Pierre Crouzet. "We had a problem with coincident calls," adds Guy Palmier. "Assuming that the five machines in a shop are at the same step, they cannot be supplied simultaneously by the two trains on each rail. The handling management controller must therefore anticipate machine demand."



In the diffusion barrier assembly plant, an automatic machine for parts preparation. Quality controls are conducted at each work station.

The dynamic storage system does not concern itself with parts-in-process. The loading of the 450-odd work stations has priority. Any one machine in a shop can supply any other machine in the next shop in the sequence. For Jean-Pierre Crouzet, the advantages of modularity are: "Flexibility above all. We can withstand any mismatches between consecutive shops resulting from irregularities at work stations. Buffer storage also simplifies maintenance."

The central minicomputer, a Mitra 125, has no command functions. "It merely receives the information from controllers, which provides a real-time picture of the plant's operation," explains Rene Rouviere. "It is a tool for statistical determination of yields, operation rates, rejects, and so on; it is also a valuable help for maintenance." The information stored on floppy discs is later used on a more powerful central computer (IBM) which prints weekly and monthly reports.

The installation and assembly plant operating at a less spectacular rate, is equally as automated. Here, the tubes are assembled into one unit, the diffuser, which resembles a large tubular exchanger. Eight tubes joined end-to-end form a candle. A group of candles is banded together into a bundle. The automation stops at that point. Several bundles are then installed in a metal shell to form a diffuser.

Breakdowns: Three Percent Due to Automation

"As in the preceding plant, we perform quality controls of all kinds, essentially pneumatic and mechanical ones, at each station," states Raoul Pimprenelle, who also adds that "all these special machines are French."

After five years of operations, Charles Oliveira takes stock: "Product quality has remained stable, handling breakage has become negligible whereas it used to exceed 6 percent in manual operation for similar production at Pierrelatte. Rejects have also been reduced by a factor of three. The computer information is very useful to quality control, to the head of production, and to the person responsible for maintenance. Finally, the machine operation rates are very high (about 70 percent!), and breakdowns traceable to automation are rare, of the order of 2 to 3 percent of all incidents."

A positive balance. And an experience which the Sfec managers expect to exploit. Delivery for Eurodif has been completed. A similar program for Coredif, affected by the worldwide nuclear power slowdown, has been postponed to an undetermined date. The rapid manufacturing rates will therefore come to a stop in July. An investment of 280 million francs (1976) will soon be idle. Confident in its expertise, and mindful of diversification, Sfec will offer to industry a mechanical and automation engineering service.

11,023

CSO: 3102/374

SCIENCE POLICY

FRG'S POSITION IN WORLD R&D COMMUNITY ASSESSED

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 17 Jul 81 p 7

[Article by Dr. Werner Gries: "Japan Dominates in Civilian Research"]

[Text] Frankfurt, 16 July--Information on research expenditures and the number of employees engaged in research is of utmost importance in judging the competitive position of the German economy, although that still says nothing about its ability to innovate. But research and development are the prerequisites sine qua non for solving the problems of the future. FRG research expenditures from 1969 through 1980 are shown in Table 1.

Table 1. FRG Research Expenditures and Research Personnel¹

Year	Total Expenditures in DM billion		Employees	Industry Expenditures in DM billion		Employees
	<u>nominal</u>	<u>real</u> ²		<u>nominal</u>	<u>real</u> ²	
1969	12.25	13.14	247,176	7.30	7.83	174,791
1970	14.80	14.80	268,000	9.00	9.00	183,000
1971	18.00	16.71	297,114	10.70	9.94	199,245
1972	19.25	16.93	299,000	11.40	10.03	194,000
1973	20.46	16.96	303,838	12.02	9.97	188,558
1974	22.29	17.29	303,304	13.24	10.27	187,000
1975	24.65	17.91	303,114	14.93	10.85	186,252
1976	25.74	18.13	n.a.	15.69	11.05	n.a.
1977	27.34	18.55	319,347	17.36	11.77	197,800
1978	29.85	19.48	n.a.	18.71	12.21	n.a.
1979	32.78	20.60	n.a.	20.72	13.02	n.a.
1980	34.72	21.29	340,000 ³	22.00	13.49	206,000 ³

1. Source: federal research minister, statistical information, Bonn No 1/81

2. According to the gross national product price index with 1970=100, author's calculation

3. Author's estimate

The nominal research outlays normally given were in this table adjusted with the gross national product price index in order to approximate real expenditures over time. In the FRG about 340,000 are employed in the field of research facilities ranging from federal institutes to research centers and in universities.

Accurate data exist through 1977. In the period 1969 through 1977 the number of workers employed in the industrial research sector increased an average of 1.5 percent annually, whereas real expenditures went up 4.9 percent. This is a phenomenon which must be taken into account to a greater degree when considering research potential. Expenditures per worker increase more than proportionally in the area of research; this corresponds with the increasing capital equipment per job. The scope of scientific equipment and instruments is especially large in the research field.

For this reason there is no parallel development for real research expenditures and number of employees. FRG research expenditures for the entire national economy grew 3.7 percent per year in real terms during the period 1970 through 1980, and thus on the average increased more rapidly than the national product. Total research expenditures in 1980 accounted for 2.3 percent of the FRG gross national product. That is a very high value in comparison with other countries. But one should not overestimate the importance of this, because the absolute number of research employees is more significant in characterizing the research potential of a country. The FRG, which is very solidly embedded in international competition, must therefore pay special attention to the industrial research capability of competing countries. Indicative in this regard is the distribution of research personnel in the most important competing countries, shown in the following table.

Table 2. International Comparison of Research Personnel for 1977¹

Country	Number ¹		Industry	
	Total	percent of OECD	Total	percent of OECD
Total OECD	2,235,089	100.0	1,337,353	100.0
United States	576,400	25.8	393,700	29.4
Japan	564,915	25.3	305,742	22.9
FRG	319,347	14.3	197,800	14.8
France	222,111	9.9	120,800	14.8
Great Britain	259,600	11.6	180,600	13.5
Other OECD	292,716	13.3	138,873	10.4

1. Full-time calculation. Source: federal research minister, statistical information, Bonn no 1/81

Despite all of the problems with these figures, certain trends are apparent, which can be summarized in the following manner: According to the number of research employees, the United States and Japan stand about equal with approximately 570,000 employees each. They provide 51 percent of all research personnel in the Western World. The FRG, with 14.3 percent of the Western World's research personnel, is far behind the United States and Japan. The number of FRG industrial research employees is 55 percent smaller than in Japan. There are only half as many employed there in industrial research as compared with the United States. In terms of research personnel, the U.S. research capacity is twice as large as that of the FRG, and Japan has a capacity not much smaller than the United States.

An international comparison of research expenditures is almost meaningless, since varying exchange rates complicate the picture and price trends also vary markedly. In addition, pay scales differ widely. The number of research workers is therefore a much more readily comprehensible means of determining research potential. Serious for the German economy in this regard is Japan's dominant role in research in the Western World. The impact of this trend has been felt for several years in the world market and it will become worse in the future.

In the FRG personnel in industry is distributed with one-third in each of the categories, scientists, technicians and others. In the universities the portion comprised of support personnel is significantly smaller, and thus the portion of scientists and technicians greater. Considering the research intensity of individual branches of industry compared with total research personnel as an existing entity, the following distribution in percent results for the individual branches: Steel machinery and vehicles, 31.5; electric engineering, precision engineering and production of business machines, 31.5; chemical industry and petroleum processing, 28.9; other industrial branches, 8.1.

The distribution of research personnel is somewhat different in the United States, Great Britain and France. Military research and development is of great importance particularly in the United States. For this reason the aforesaid dominant Japanese role in research personnel is even more significant, because in Japan military research capacity on civilian needs. When one considers civilian research and development personnel only, then Japan is the leader within the Western World ahead of the United States. In part, this is occurring to the detriment of civilian research.

9746

CSO: 3102/361

TRANSPORTATION

CITROEN VISA II NEW TECHNOLOGY MOTOR

Paris L'ARGUS DE L'AUTOMOBILE in French 2 Apr 81 pp 16-17

[Article: "Citroen Via II: A Still More Economical Engine"]

[Text] Without question, the new Visa II Super E marks a stage in the recovery of PSA [expansion unknown]. The marriage of a Citroen body to a Peugeot engine had not yielded the anticipated results. The style (both interior and exterior) of the Visa had very little attraction, while the 104 engine, after all brilliant, had some sizable drawbacks, namely uneven idling, more than critical cold starts, all depending on the design of the intake pipe, unfortunately incorporated in the cylinder head.

Talking About Style Again

To return briefly to style before going on to the metamorphoses in the engine, in terms of anthropomorphism. The geometry of the "face" and of the "shapes" of our automobile companions give rise to a constant (but unexpressed) reference to human features in our minds. Thus, in the postwar automobile, the severity of the Peugeot 203 and 403, marvelously reflecting the steadiness and reliability of the make, were contrasted with the "feminine" seductiveness of the Aronde, whose headlight visors were even reminiscent of the eyelids and look of motion-picture stars. Closer to us, the advertising campaign announcing the Renault 5, with designed stripes, had provided it with eyes and a mouth (that talked), accentuating the likable and malicious side of the product (which was messed up by FIAT for the "malicious" Panda). The excessive, deliberate simplification of these examples must not make us forget that this unconscious perception of the model's personality and the harmony achieved with the buyer's sensitivity (regardless, moreover, of his sex) are both one of the greatest mysteries of style and, as a corollary, its most magnificent justification.

The narrow radiator grille of the former Visa I and the triangular hood that it necessitated reminded us of the architecture of the "2-legs." Therefore, it seems obvious that the "Special" and "Club" models were favored by the owners of Dyane and 2 HP 6, while the "Super" model found it difficult to compete with the Peugeot R 5 and 104, with more of a "big car" design, while they had, however, approximately the same dimensions and performance.

At the cost of more important modifications, now the Visa II is more attractive, more in conformity with the taste of the moment, provided with a much better "selling design." It is to be hoped, with the help of success, that one day they may

review the dashboard design. A priori, we are not opposed to the "goat's milk cheese" on the left (headlights, turn signals, and so on) or to the square of Brie on the right (heater), but there too it could be made more simple and restful to the eye without losing any of the ergonomic features of the unit.

"Vade retro"

The work performed by the Peugeot technicians when they modified the Citroen 104 engine and by Citroen technicians when they adapted it to the Visa II deserves telling, because it is exactly the opposite of what was done only 10 years ago!

At the time of the power race, fuel consumption was of moderate concern with a desperate attempt to attain higher power. Today, priority is given low consumption and everything making it possible to achieve it. In the 1- to 1.3-liter class, it is absolutely necessary to beat the "standard" that the engine of the R5 GTL, mostly responsible for the exceptional "multifaceted" image of the R5, has become.

Therefore, it will probably not be amazing to see that the PSA motor mechanics have used every "trick" of the trade to modernize the 104, including adoption of an electronic ignition system accomplishing what our grandparents were unable to accomplish in the golden age of the automobile, with their "tremblers" quickly superseded by magnetos!

The fact that the most modern techniques have a "retrograde" side does not displease us, insofar as there is a considerable number of clever inventions pertaining to the four-stroke engine that could not be carried through owing to a faltering technology but that can now be brought to successful conclusion thanks to ultraperforming metals, lubricants and electronic circuits!

Breathe!

A high compression ratio is the gauge of good performance. The 109/5E engine of the Visa II Super E increases to 9.7 from 9.2. This considerable increase has been achieved simply by means of a greater piston displacement, but it increases the need for using a quality superfuel.

The modification of the intake pipe is just as important. Previously integrated, it becomes only partly integrated, because the new design makes a better adjustment of the nozzles and balancing of feed possible. Up to now, the two center cylinders were rather richly supplied while the outside ones were rather poorly fed. Another advantage is that preheating of the carbureted mixture is improved. The result is that the cycle performance is improved and, owing to the greater cyclic regularity, it is possible to lower the idling rate from 900 to 750 rpm. Consumption is lower. This is especially noticeable in city driving.

Uncross!

A camshaft is said to be "crossed" when it makes simultaneous opening of the intake and exhaust valves possible for a certain period of time. The pressure waves created by the sudden expansion of hot gases cause a "compression" effect in the intake, admirably filling the combustion chamber with carbureted mixture. Most often, balance between intake-exhaust frequencies, difficult to achieve, occurs only at a high rate, but it increases the power of engines considerably.

The Visa Super E had a crossed pattern: AOA (advance on intake opening) of $5^{\circ}20$ in relation to the PMH (upper dead center of the piston), AOE (advance on exhaust opening) $36^{\circ}50$ in relation to the PMB (lower dead center of the piston), RFE (delay on exhaust closing) $5^{\circ}20$ in relation to the PMH.

With the new engine, they go from an AOA of $5^{\circ}20$ to an ROA (delay of intake opening in relation to the PMH) of 4° , while the RFE of $5^{\circ}20$ becomes and AFE (advance on exhaust closing) of 5° !

Thus, they have gone from a crossing of $10^{\circ}40$ to an "uncrossing" of 9° ! From now on we wisely expect exhaust to be closed 5° before PMH before opening the intake 4° after PMH!

This modification of the pattern is accompanied by a decrease in valve lifting from 8 to 7.35 millimeters. Thus, the gases are accelerated at low and medium speeds and fill the cylinders better. This results, still at these low and medium rpm's, in an increase in power and torque, reduction in the idling speed and lowering of the maximum torque rate.

Carbureate, Ignite!

All the intake pipe and camshaft modifications make it possible to burn leaner mixtures (less rich in fuel). Therefore, the carburetor has been modified taking the following into account: nozzle 24 (25 for the old Visa), main jet 120 (127.5), automatic jet 150 (155), idling jet 41 (42), acceleration pump injector 35 (40). With regard to the full-load enricher, it is controlled mechanically and is, therefore, more accurate. It is possible to run longer with lean mixtures.

On the other hand, although these mixtures are more economical for the user, they are harder to ignite. Therefore, an ignition system with performance and accuracy has to be used. That has already been accomplished with a rather simple transistorized electronic ignition system.

It includes the following, in addition to the coil and the sparkplugs:

A distributor equipped with a traditional centrifugal advance mechanism, depression advance, an HT (high voltage) current distribution rotor.

A pulse generator. The traditional points have been replaced by a polar wheel (non-magnetic 4-armed star) turning in the field of a permanent magnet. It produces an induced current in the coil of the magnet (the collector).

An electronic module that triggers the ignition voltage at the rate of the pulses received from the generator. It consists of four components: a logic controller, a power stage (amplifier) and two control and reaction units (dwell and current reading).

The advantages of this transistorized ignition system are important:

It provides high energy (28 kilovolts) constant over the entire speed range, facilitating cold starts and combustion in general (less consumption and pollution).

Absence of friction and contacts frees it from maintenance and adjustment (the advance point remains stable).

Of course, adoption of this ignition system may seem to be a step backwards in view of the "all electronic system" promoted here and there, including by Citroen. Problems of feasibility, of cost and of maintenance, very familiar with this kind of equipment, show that Citroen decided on a certain wise course and shelved the more advanced technological dreams. Consumers and the network are grateful to it in advance.

In conclusion, we must salute this efficient job, which may seem to be going in a direction opposite to a certain evolution, precisely because it is going in the right direction, the direction of fuel economy, while not spoiling the pleasure of driving. Recently, a FIAT engineer who works on the future 1-liter PSA-FIAT, confessed his joy to us (and his amazement, it is true!) at collaborating with so well-qualified engineers. If there had been doubt for an instant of our technicians' worth, the 109/5 E of the Visa II would have provided the finest contradiction to these doubts.

Comparative Characteristics of the Visa II Super E, R5 GTL, 104 GR Models

	<u>Visa II Super E</u>	<u>R5 GTL</u>	<u>104 GR</u>
Engine			
Cylinder capacity (cc)	1124	1108	1124
Compression ratio	10.2/1	9.5/1	10.2/1
DIN power (horsepower-rpm)	50-5500	45-4400	50-5500
DIN torque (kilogram-meters - rpm)	8,4-2500	8.7-2000	8.5-2500
Fuel Consumption (in liters per 100 kilometers)			
At 90 kilometers/hour	5.1	4.9	5.2
At 120 kilometers/hour	6.6	6.8	6.9
Average, highway (90 and 120 km/h)	5,85	5,85	6,05
Average, city	7.0	6.3	7.3

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END

JPRS 78926

8 September 1981

West Europe Report

SCIENCE AND TECHNOLOGY

No. 73



FOREIGN BROADCAST INFORMATION SERVICE

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8 September 1981

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No. 73

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CHEMICALS

ICI ANNOUNCES DISCOVERY OF BIOTECHNOLOGICAL POLYMER

Paris INFORMATIONS CHIMIE in French May 81 p 123

[Article: "ICI: Biotechnological Thermoplastic"]

[Text] Dr Peter King, director of the Agriculture Division of ICI, at the second European Conference on Biotechnology in Eastbourne, announced the discovery of a revolutionary polymer manufactured using a biotechnological process; the polymer is a polyester, poly-2-hydroxybutyrate (PHB).

Glucose from corn is converted into the polymer by a bacterium, *Alcaligenes eutrophus*, of which PHB constitute 80 percent of the cellular mass. With this bacterium it is possible to obtain a PHB whose physical properties do not vary with the substrate.

According to Dr King, the U.S. company W. R. Grace had already worked on a type of PHB produced by microorganisms, but the originality of the ICI process rests with the method used for separation and purification of the polymer.

The product obtained, $(CH(CH_3)CH_2COO)_n$, where n is between 5,000 and 10,000, is a high molecular weight thermoplastic whose stereoregularity offers some attractive features. It can be plasticized and oriented or reinforced with glass fibers, and it is biodegradable in the soil. It is more dense than polypropylene (1.25 versus 0.905), and its glass transition temperature is higher, but it is less resistant to solvents; on the other hand, it is more resistant to UV. ICI presently produces 10 kg of this product per week, which is far from competing with the petroleum-derived polymers, but nevertheless the product is a fascinating example of the possibilities of biotechnology.

Properties of PHB and Polypropylene Compared

<u>Properties</u>	<u>Units</u>	<u>PHB</u>	<u>PP</u>
Melting point	°C	175	176
Crystallinity	%	80	70
Molecular weight	daltons	5×10^5	2×10^5
Glass transition temperature	°C	15	-10
Density	g/cm ³	1.250	0.905
Flexural modulus	GPa	4.0	1.7
Tensile strength	MPa	40	38
Elongation at break	%	6	400
UV resistance		good	poor
Resistance to solvents		poor	good

9828

CSO: 3102/378

ENERGY

HIGH-TECHNOLOGY ALTERNATE ENERGY PROJECTS USE NEW MATERIALS

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 7 Jul 81
p 1

[Article by Hellmut Droscha: "Wind and Sun as Primary Energy"]

[Text] Frankfurt, 6 Jul--Fiber composites have found acceptance in power engineering as well. For example, a high-voltage transformer has been provided with a puncture-proof cover made of glass-fiber reinforced plastic, and a wind-tunnel fan has been given rotor blades designed according to the "sandwich construction" out of glass-fiber and carbon-fiber reinforced plastic layers (MBB [Messerschmitt-Boelkow-Blohm GmbH]).

And recently work was completed on the prototype of a "large wind-energy facility" [Grosse Windenergie-Anlage]--named "Growian" for short--which is being erected in Brunsbuetel. Its two rotor blades, 50 meters in length, have a steel spar structure with an external contouring done with long-fiber composite plastics, which increases strength. For the tip of the blade in each case, carbon-fiber reinforced plastic was chosen, and for the remainder--that is, the main part--glass-fiber reinforced plastic was selected (M.A.N. [Augsburg-Nuernberg Machine Factory, Inc.]). This facility is designed for a power-generation capacity of 3,000 kilowatts. It consists of a tower 100 meters high, at the top of which the two-bladed rotor turns around its horizontal axis. Moreover, the rotor bearing arrangement located within the tower top, together with all the mechanical equipment, is also pivoted about the vertical, so that the rotor can always be "turned into the wind" in the manner of a windmill. This rotor drives two electric generators by way of the interconnection of a high-transmission gear unit. These generators produce their maximum power at a wind velocity of 12 meters per second. In the interior of the tubular steel tower, a passenger elevator is installed.

An alternative to this system of a wind-energy converter with a horizontal rotational axis and a two-bladed rotor similar to a gigantic propeller has been developed by another party. In this new system (Dornier), the rotational axis is vertical and is constructed like a tubular or lattice-type tower. Moreover, the three rotor blades have nothing in common with a propeller, but call to mind an archery bow, which here (with the omission of the stretched string) is fastened always to an upper and a lower point on the axis of rotation. The symmetrically curved shape of the three "bow blades," which are positioned

at angular spacings of 120 degrees in each case around the axis of rotation, catches the wind with its concave side, while this wind flows off on the convex side--similar to what happens also with the hollow-sphere shells of the familiar wind-measuring instruments. Serving as an aid to starting are two mini-rotors installed around and close to the axis of rotation, which have a basically cylindrical shape and which are reminiscent of the Flettner ventilators in the ceilings of former buses.

Thus this facility, with its markedly simple structure--which for now is being built with small dimensions--is able to dispense with all external power sources, and since it is independent of wind direction it never needs to be shifted around. Also its maintenance needs are small. Its basement is the location for the easily accessible utilization unit, which can be either an electric generator or a pump for delivering drinking water from a well or for irrigating relatively small agricultural areas.

The bow blades of the main rotor are manufactured in one piece from an extruded aluminum alloy, but they can also be fabricated from other material which may be available at the site. One small prototype design with a rotor diameter of 5 1/2 meters and a power of 4 kilowatts at a wind velocity of 10 meters per second is in operation both on the North Sea island of Pellworm and on the Black Forest mountain of Schauinsland. On the very windy Atlantic coast of Patagonia in the southern part of Argentina, already a somewhat larger facility with a rotor diameter of 12 meters is furnishing a power of 20 kilowatts.

Still in the early stages of development is a technique on the basis of which solar radiation can be converted directly--that is, under a blue sky, or as diffuse light with an overcast sky--into heat or into electric power. In fact, this is done without any additional devices such as mirrors or lenses, by means of a transparent medium which serves as the collector--for example, plexiglass--in which a fluorescent pigment is embedded. That is to say, this pigment absorbs incident light within a certain spectral range and radiates light of somewhat longer wavelengths as fluorescence. Because of the total reflection involved, as the physicists explain (Work Group for Solar Energy Systems of the Fraunhofer Society), a large portion of the generated light is guided along within the transparent plate, at whose ends one can extract it. If it should prove possible to solve all the problems which still stand in the way of an economical output here, then we will be able to obtain solar heating and solar power based on this principle much more cheaply than can be done at present.

With the aid of solar energy, one can also desalinate sea water and convert it to drinking water. In La Paz, capital of the Mexican territory of Baja California Sur, a relevant small facility has come into being (Dornier, M.A.N., Siemens). By means of the solar heat collected by the total of 680 square meters of solar-collector area, this facility generates 10 cubic meters of drinking water daily out of sea water on the basis of the principle of multistage flash evaporation. Only the electric driving power for the pumps is still provided in the conventional way.

Now of course one must realize that, seen in a world context, facilities of this order of magnitude are only "a drop in the bucket." Because the unremitting growth of the world's population and the rising standard of living with increasing industrialization are leading inevitably to the situation where the earth's fresh-water reserves are being drawn on more and more, and because of this they are either approaching depletion or else their salt levels are rising.

ENERGY

SWEDISH CONSORTIUM PLANS SYNTHETIC FUEL PLANT

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 23 Jul 81 p 7

[Text] The three Swedish companies Asea, Nynaes Petroleum and Stoseb, the communal energy-generating concerns of greater Stockholm, have agreed on the formation of a consortium to propose a plant to produce synthetic fuels. This proposed plant is to be built in Nynaeshamm, about 30 kilometers southeast of Stockholm and to be put into operation in 1987/88. The total cost is estimated at \$400 to \$500 million. It is calculated that the amount of fuel produced will be sufficient to meet one-tenth of the gasoline consumption in Sweden. In addition to fuel, hot water can also be produced for the district heating supply of Stockholm, as well as synthetic heating gas. Sweden's crude oil imports might be reduced in this way by about 1 million tons, the companies believe.

The basic materials will be principally coal and heavy oil. Gaseous and liquid fuels (methanol or synthetic gasoline) can be obtained through gasification and synthesis. The low-grade effluent heat from this process is to be utilized for district heating. In contrast to traditional gasification of coal or the burning of heavy oil for heating gas and hot water generation, there would be only low levels of emissions in the proposed plant. Pollution from sulfur dioxide, for example, would be reduced by 10,000 tons annually.

Energy consumption could be reduced still further through the use of heat pumps in the district heating network of greater Stockholm. The return water would have a lower temperature before reentering the energy complex. Heat pumps would also be suitable for reclaiming energy from the low-grade effluent heat. About 70 percent of the oil currently used for home heating in Stockholm could be saved by this method.

9581

CSO: 3102/375

ENERGY

RESEARCH MINISTER CALLS FOR EXPANSION OF DISTRICT HEATING

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 7 Jul 81
p 1

[Article by "K. B.": "District Heating Is To Be Extended"]

[Text] Bonn, 6 Jul--District heating must be greatly expanded. This is what Federal Research Minister von Buelow called for on Monday in Bonn. Von Buelow intends to work toward seeing that district heating is given "a great deal more" consideration in the third updating of the Federal Government's energy program. Notwithstanding all our economizing, governmental support for district heating must not be shortchanged, he said. Its funds must be increased in the new version of the Federal Government-Laender program for the support of energy conservation. Von Buelow does not believe it is necessary to have a compulsory hook-up and use requirement for people in the vicinity of district-heating grids. As for the controversial district-heating levy, which is still being examined in a study, von Buelow believes that on this question there is "no immediate need for action" at the present time. He said that the crucial prerequisite for the expansion of district heating networks is cohesive local and regional supply plans.

Such a plan for supplying the Ruhr has now been proposed by the Association of Ruhr Communities to the Federal research minister and to the Land of North Rhine-Westphalia. An overall plan is to be prepared at a "Ruhr district-heating conference" by all enterprises which have a share in the district-heating market in this area. The director of the communities' association, Juergen Gramke, gives assurances that the heating-supply market mechanism is to be limited as little as possible by this plan. He said that it must be realized in a businesslike way and must be calculated in terms of managerial economics. On the other hand, he said, we should put an end to the situation where the private and municipal enterprises obstruct one another in the heating market.

In the opinion of the research minister, the expansion of district heating is a necessary economic and political decision, because thereby the energy reserves, the environment, and foreign exchange could all be conserved at one blow. Some 20 to 25 million tons of hard-coal units could be saved annually through district heating. Its share in the district-heating market [sic] could rise to at least 25 to 30 percent in the next 10 to 15 years. This changeover in the heating market takes time. It would be unrealistic to expect extensive changes in a few years.

INDUSTRIAL TECHNOLOGY

FRAUNHOFER WORKS TO DEVELOP, IMPROVE SEEING ROBOTS

Duesseldorf HANDELSBLATT in German 22 Jul 81 p 20

[Article by Uwe Ahrens: "Robots Getting Better and Better at Recognizing Parts"]

[Text] The small number of industrial robots in use in comparison to the large number of manipulation tasks which are still manually executed can be explained on the basis of economics and the sensory deficiencies of industrial robots.

The human being, with the aid of his sensory organs, can iterate manipulations in such a way as to satisfy 1,020 different boundary conditions. A sensory faculty for industrial robots can make possible a connection between the environment and a programed work process which will yield a coordinated behavior adapted to the situation.

An important task of automatic manipulation, in addition to parts identification, is the determination of location and angular orientation of partially ordered parts as a precondition for grasping by an industrial robot.

Under certain boundary conditions related to the field of application, this task can be accomplished with the help of video sensors. With the aid of a camera the field of view is converted into electrical signals, partially or totally stored in binary form and evaluated by a wide range of processes depending on the application. The results are presented to the industrial robot as a part number and position coordinates.

Such a task-related robot system was recently exhibited at the Hannover Fair by IPA (Fraunhofer Institute for Production Engineering and Automation, Stuttgart). This solution involves the flexible handling of sundry parts presented on a conveyor which is fed by a supply bin. Since it would require a great deal of effort to mechanically preposition the many individual parts for the robot, a video system coupled with an industrial robot is used in this case. This makes it possible to accommodate the associated constraints, such as touching or overlapping parts, with relatively little outside intervention.

At IPA the current thrust in the sensor area is directed at accomplishing the following objectives:

--Removal of obstacles to practical application of video sensors;

- Development and realization of efficient, standardized interfaces between sensors and industrial robots; and
- Integration of the sensor camera in the robot's gripper.

Because of its central role in applied research, a principal aim at IPA is to bring the number of industrially applied sensors more into line with the number proven under laboratory conditions.

Practical application is hindered by limiting constraints which are determined mainly by the type of object presentation required. With the aid of the projects carried out at IPA, potential solutions are designed and their economics demonstrated.

Unavailable and nonstandard interfaces mean necessary development work for the user and hinder the application of sensors since the necessary access to system software for industrial robots and sensors is not provided. To effect the required transformations of geometric data as well as the coupling between sensors and industrial robots, an additional computer must often be used as an interfacing agent.

IPA is working with other institutes and industrial firms on several committees to generate a recommendation for a standard interface for complex sensors. This recommended practice will specify which interface functions will be assigned to the robot's control system and which to the sensors.

As a rule, the relative position between the part to be gripped and the robot's gripper or between the part and its terminal position will be determined with the video sensor. Difficulties which are expected to be overcome through appropriate research and development work at IPA arise from several sources: camera size; mounting location (visual obscurance by the gripped part); varying observation distance (focusing and scale changing) and varying directions of observation.

The breakthrough in the use of video system can only be expected when grey-tone picture preprocessing makes possible the evaluation of randomly presented parts. Reasonable evaluation times will be achieved only through application of new computer structures with array processors which are tailored for parallel picture processing.

9160
CSO: 3102/376

INDUSTRIAL TECHNOLOGY

BRIEFS

BMW ORDERS ASEA ROBOTS--The Swedish firm ASEA recently received a contract for 67 IRb 60 industrial robots with a load rating of 60 kp from the Bayerischen Motoren-Werke AG (BMW), Munich. The robots will be used for resistance welding work.
[Text] [Essen ELEKTRO-ANZEIGER in German No 10, 1981 p 10] 9160

CSO: 3102/376

SCIENCE POLICY

POWERS OF RESEARCH MINISTRY UNDER DISCUSSION

Paris AFP-SCIENCES in French 18 Jun 81 p 4

[Article: "Powers of the Ministry of Research and Technology"]

[Text] Paris--The Council of Ministers on 17 June approved new authority for the Ministry of Research and Technology, according to sources at the Ministry.

The powers of the Ministry of Research, it seems, are in line with the statements made by the minister, Jean-Pierre Chevenement, on 26 May of this year (see AFP-SCIENCES No 264, 27 May 1981, pp 1-2) when he expressed to the press his desire to rearrange, under the supervisory control of the Ministry of Research, most of the major technological research and development organizations which under the preceding governments were answerable to a number of different ministries, particularly the Ministry of Industry.

If these recommendations are signed by the prime minister and the four ministers involved (research, industry, education, and foreign relations), the Ministry of Research would exercise supervisory authority over five organizations: CNRS [National Center for Scientific Research] (formerly under the Ministry of Universities), the National Agency for Valorization of Research (ANVAR) and the Delegation for Innovation and Technology (formerly under the Ministry of Industry), and finally two organizations, the General Delegation for Scientific and Technical Research (DGRST) and the Interministry Task Force for Scientific and Technical Information (MIDIST), which were already under the supervision of what was then the office of the secretary of state for research [now the Ministry of Research and Technology].

In addition, the Ministry of Research will be provided with three types of jurisdiction over all the other major civil organizations for technological research and development (CNES [National Center for Space Studies], AEC [Atomic Energy Commission], CNEXO [National Center for Exploitation of the Oceans], INRA [National Institute for Agronomical Research], etc.).

The first type of authority is over the preparation and implementation of the budgets of these organizations. In fact this financial oversight represents a return to having a grip on the totality of the "research envelope," about Fr 20 billion in 1981. This "envelope" will no longer be limited to basic research as it was in the past, but will also include the major technological programs (nuclear, space, oceanography, information processing, etc.).

These programs and the organizations which implement them (CNES, CEA, etc.) will still be subject to oversight on the part of their ministry of origin.

The other two types of authority pertain to the power of the Ministry of Research in the matter of organization or reorganization of the major civil research organizations and in the matter of status and use of their personnel.

The people at the Ministry of Research emphasize that in all these domains--financial, personnel policy, and management of organizations--it will act "in liaison" with the other ministries concerned.

9828

CSO: 3102/378

TRANSPORTATION

FRENCH AUTOMAKERS EXPLORE USE OF LIGHTWEIGHT MATERIALS

Paris INDUSTRIES & TECHNIQUES in French 10 May 81 pp 28-32, 34

[Article by Alain Perez: "Steels-Plastics: 'Star of the Show'"]

[Text] One hundred kilometers on 3 liters of gas. For the future, the automakers' goal is one of austerity. To attain this objective by about 1990, research has been set up on three axes: aerodynamics, engine and transmission component efficiency, and materials; 10 years from now our automobiles will be more finely built, higher in performance, and lighter in weight.

The Renault Eve has an aluminum skin. The Peugeot Vera prefers the composite materials. These latest additions from the French automakers presented at last year's Auto Show are still in the prototype stage. Prepared in haste pursuant to an agreement worked out with the Agency for Energy Economies, these two experimental vehicles, very different in their definition, have now been left behind--more exercises in style and consciousness-raising operations than industrial realities. Nonetheless, the movement is under way.

Today the talk turns to the Vera Plus, Eco 2000, Plume, and Vesta. Concealed behind these acronyms are some very solid plans. Little in the way of spectacular changes is to be expected before 1985. The auto industry's production machinery, jammed before, still moves ponderously.

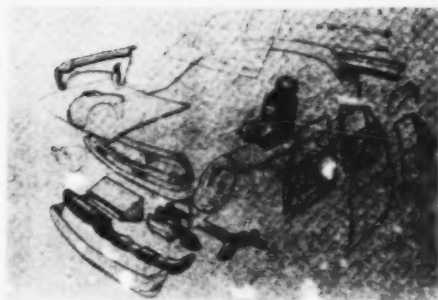
Around 1990, a new generation of low-energy cars will come on the scene, at Peugeot as well as at Renault. The idea is to produce a lower echelon vehicle for mass distribution. Its fuel consumption should approach about 3 liters/100 km in urban driving and about 2 liters/100 km when stabilized at a speed of 90 km/hour. To win this bet, the choice of materials is crucial: 100 kg less mass in motion will mean 0.5 liters less fuel consumption.

Today, there is at least one certainty. The big loser from these changes for which preparations are under way in Rueil [Renault] or in Sochaux [Peugeot] will be cast steel. Even if the foundrymen further refine their crude materials, the handicap of density would appear insurmountable. On the other hand, the models which will appear beginning in 1985 will progressively render obsolete 20 million of the automobiles in service in France. Barring a total breakdown of the system, the costly energy should be a fantastic argument for revitalizing a dormant market.

The French automakers do not all have the same approach. At Peugeot, there is a firm belief in the new materials, particularly the reinforced plastic materials. At Renault, the leanings are toward improving the aerodynamics of the body and the efficiency of the drive train. A low rolling inertia is valuable at low speeds; penetration into the air becomes a significant factor beginning at about 90 km/hour. As for the efficiency of the present internal combustion engine (less than 0.3), it is so low in any case that improvements are inevitable.

"For the Eco 2000 project, the efforts begin with a blank page. Anything can be right* provided it can be industrialized at a production rate of 1000 per day," remarks G. Sifre. Sifre, of the Peugeot group's very recently formed Directorate of Research and Scientific Affairs (DRAS), is resolutely in favor of the composite materials. "By 1990, it will be possible to fabricate a plastic body in 1 minute."

Some figures illustrate the irresistible rise of the plastic materials at Peugeot: 74 kg on the 305, 167 kg on the Vera, 190 kg on the Vera Plus, and 250 kg on the Eco 2000. The reinforced plastics follow a parallel progression in this balance sheet: 1 kg on the 305, 67 kg on the Vera, undoubtedly more than 100 kg on the Eco 2000. The total weight of the vehicle itself follows a descending curve.

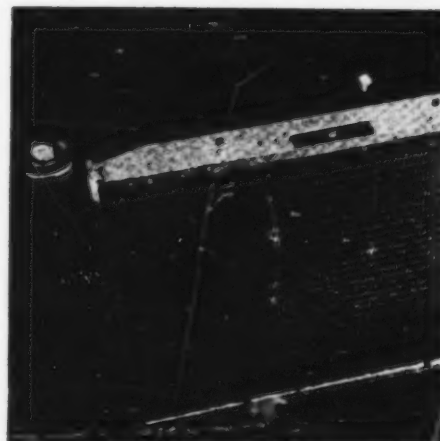


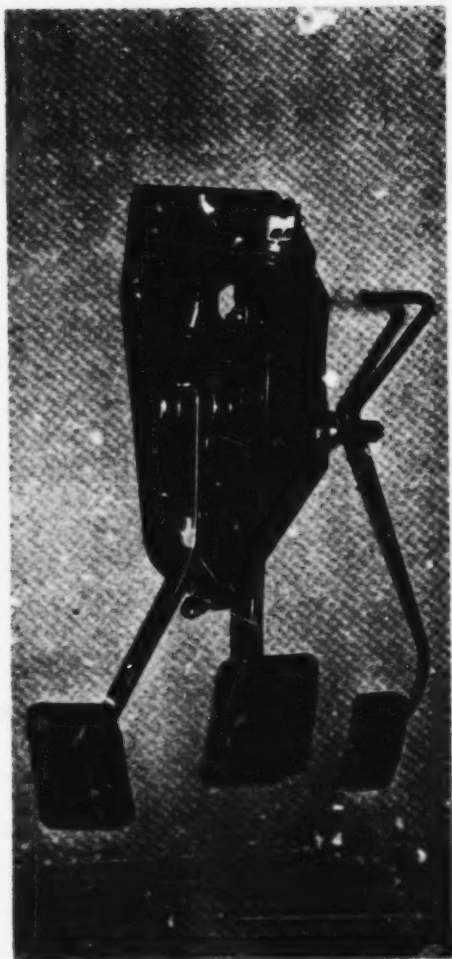
On the Vera prototype, the body frame is made of high-elastic-limit (HCE) steel, and the moving parts are made of composite materials. The overall weight reduction of the body is about 77 kg. (Peugeot file photo)



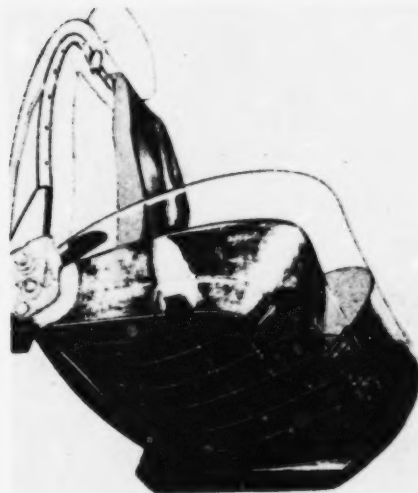
The front frame of the Vera: made with glass-fiber-reinforced polyester and molded SMC. (Peugeot file photo)

The drive train peripherals were lightened about 11.7 kg, particularly by use of an aluminum radiator. (Aluminium Pechiney file photo)

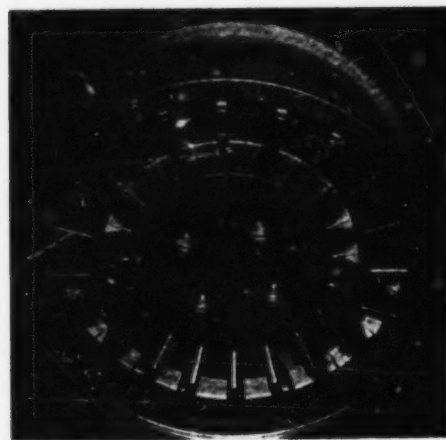




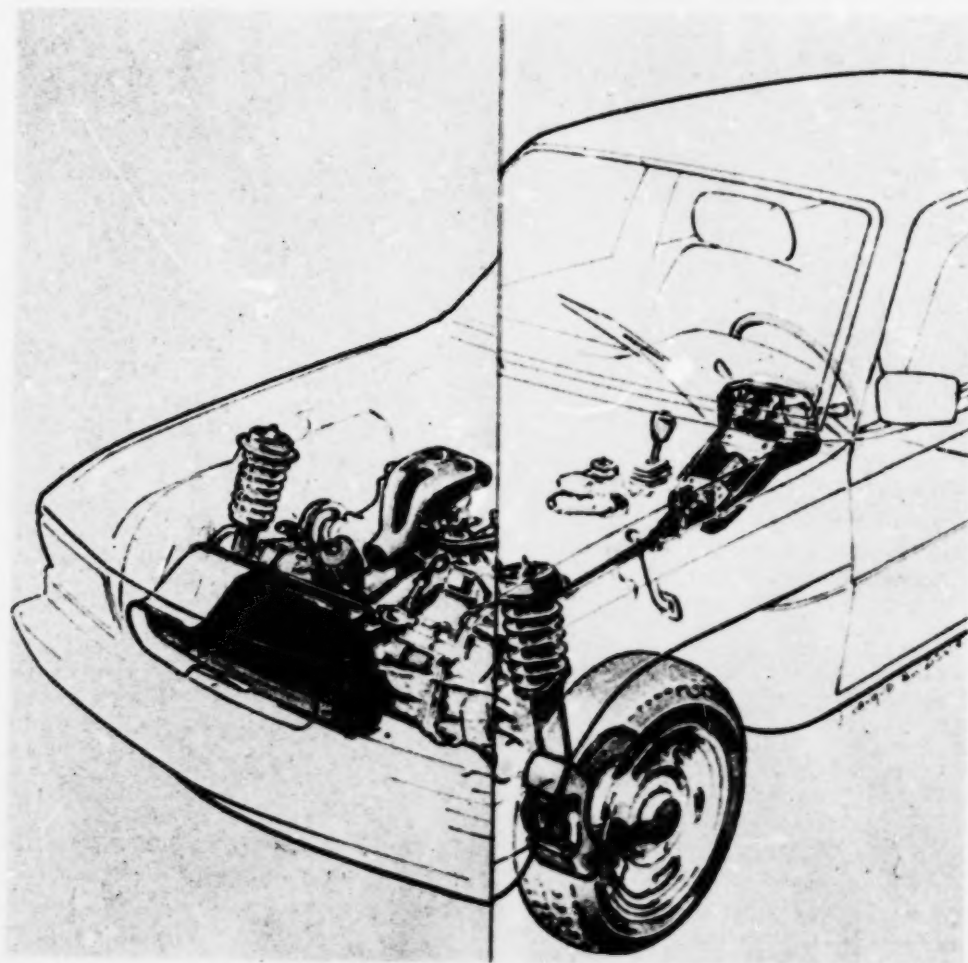
For the pedal cluster, the manufacturer also turned to synthetic materials. The pedals are made of aluminum tubes. (Peugeot file photo)



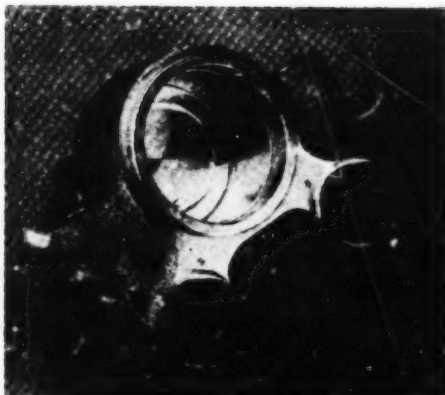
The front seat also is made with SMC. The framework of the seat is made of glass-fiber-filled polypropylene. The saving is about 1.4 kg. (Peugeot file photo)



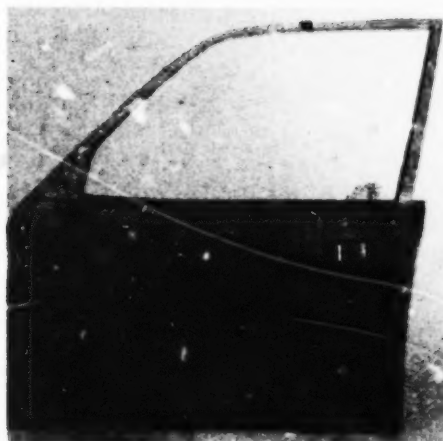
Wheel rim traditionally made of sheet metal steel or of light alloy are today made of composite. The saving exceeds 1 kg. (Aluminium Pechiney file photo)



The mechanical parts of the Vera are also lightened: timing chain cover made of magnesium, rocker arm cover made of polyamide, exhaust manifold made of sheet metal. (In all, an additional saving of 3 kg.)



An old application revived: on the Vera, brake calipers made of aluminum. (Photo by Longchamp-Desmarteau)



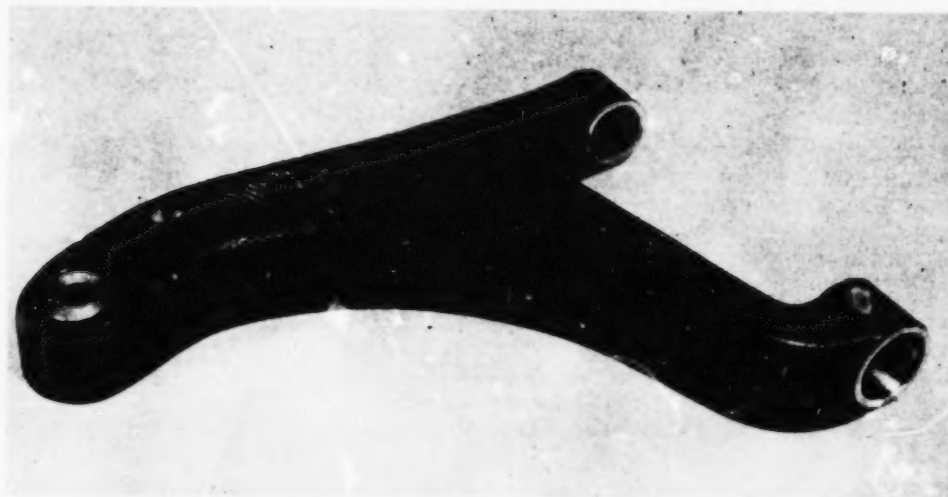
The weight difference between the sheet metal of the door of the [Peugeot] 305, and the SMC (sheet molding compound) utilized on the Vera is 14 kg. (Peugeot file photo)

These changes are not taking place without problems. In Sochaux a limited series of 5,000 [Peugeot] 104's is being produced with a hood made of glass-fiber-reinforced polyester. In tests on the assembly line, it was found that a body without a hood (unprotected in the plastic version) would no longer pass through the electrophoresis tanks. The body was too light. It was necessary to devise a false hood which could be removed after the operation. Examples of this kind abound. One of the numerous problems to solve on the production lines will be the cohabitation of different materials with different resistances to temperature, impacts and chemical agents and different characteristics.

In addition to their insensitivity to corrosion and their lightness, the plastics offer other structural advantages. "In case of a frontal impact at 50 km/hour, one is in a better position with reinforced plastics than with steel." If the U.S. regulation for front-end impact without deformation at 8 km/hour is imposed in Europe (which may not manage to delay), cowls made with reinforced fibers [sic; more likely fiber-reinforced plastics] may become commonplace.

The plastic menace is now weighing more and more heavily on steel. After having practically filled the interior of the passenger space, the high-performance plastics in the future are going to gain ground in body parts. The first to make it around the cape will be the opening parts (hood, door, tailgate). Since the pioneering use of polyester for the roof of the [Citroen] DS (in 1955) the advances have come steadily. On the Vera, the door made of molded reinforced plastic SMC (sheet molding compound) weighs 7.4 kg against 11.2 kg in its sheet steel counterpart. The assembly in front of the cooling system of the [Citroen] GS made of composite weighs 2.5 kg against 3.75 kg. These are decisive advantages, all the more so as each kilogram saved on the body implies a supplementary saving of 0.4 kg in the support structures.

Some inconveniences remain, to be sure: the cost of the high-modulus fibers, the difficulties and risks of manufacture, the still insufficient production rates. However, at the bottom line, the balance remains favorable. The competition among the numerous suppliers leads to rapid improvements. G. Sifre is explicit in offering his views: "The Billion firm already has at its disposal a process for fabricating an underframe and a body in the automobile time setting. As for the starting materials, we have the necessary competence in France. There are just a few places where it is necessary to rethink the car." At Peugeot, developments have been pushed very far "for their own sake." A suspension arm made of carbon fiber and glass fiber embedded in resins has been realized by Citroen. The final weight of the part is about 1.4 kg, or nearly 50 percent less than its metal counterpart. This arm includes two U sections assembled by adhesive bonding. One is made of carbon fiber in an organic matrix, the other of glass fiber. The first absorbs flexural stresses, the second torsional stresses. The metal sleeve which receives the cylindrical knuckle is countersunk into an insert also made of resin. This project, realized in conjunction with SEP [European Propellant Company] (which fabricates the Ariane rocket engines) in St-Medard-en-Jalles (near Bordeaux), has benefited from a DGRST [General Delegation for Scientific and Technical Research] contract. The static tests show a satisfactory strength, and the fatigue tests are presently in progress at the Citroen Technical Center in Velizy. This very avant-garde solution is far from being industrializable at the present price of carbon fiber.



The ultimate example of the present technique: a suspension arm made with carbon fibers and glass fibers. It was developed by Peugeot, Citroen, and SEP. (SEP file photo)

At Renault, they are more circumspect: "The spring made of carbon fiber: it is not serious," they say at the Rueil Center for Studies (a limited series of 1981 Chevrolet Chevettes is equipped with a single-leaf suspension spring made of carbon fiber). "I do not believe that the plastic materials provide an answer," states a materials specialist. "Carbon fiber is too expensive, and it is not known how to cut Kevlar fiber, much less how to assemble these materials."

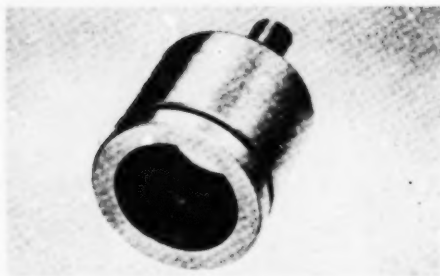
Like Peugeot, Renault has a series of lightened prototypes undergoing research. "Not much of a revolution [is expected] before 1985. Already 130 kg has been saved, and another 60 to 80 kg can be pared. The problem has been formulated, but one is still faced with blank pages." Despite an obligatory prudence, plastics are gaining ground slowly. Little by little the progression led to the rocker arm cover made of polyamide. A year from now, some plastic hoods will go into series production on a trial basis. The preoccupation with sales and with acceptance of the new changes by the buying public remains very much in evidence. "It is necessary to build light but not cheap. The public is used to a polished appearance. Will plastic in the body be very marketable?"

The engine of the [Peugeot] 104 includes a number of weight reduction features--magnesium carburetor, polyamide rocker arm cover, lightened engine flywheel, and so forth--nearly 5 kg in all. (Peugeot file photo)



In fact, and despite the experience with the Eve (on which the entire body was made of aluminum) they remain very "sheet metal" and very "cast metal" oriented at Renault. Of all the French manufacturers, Renault is the one which utilizes the least aluminum, another protagonist of choice in the fight against weight: 33 kg on the average per vehicle, as compared to 50 kg at Peugeot and 54 kg at Citroen, according to data from Pechiney. The Renault 4 contains 15 kg of aluminum; the Citroen CX GTI contains 103 kg. It is true that the price of aluminum causes it to be reserved for use on upper echelon cars (150 kg on the Porsche 928, 110 kg on the Mercedes 450).

Despite its price and its high energy content, aluminum also holds an important card to play in the years to come. "The opportunity for aluminum is especially strong in molded parts," thinks J.-L. Mazodier of Pechiney. The penetration of this metal in France is already total or substantial for a number of motor components (100 percent of the cylinder heads and pistons, 44 percent of the engine blocks). According to the forecasts of PUK [Pechiney-Ugine-Kuhlmann], the average 1985 automobile should contain more than 45 kg of aluminum as compared to 40 kg at present. The first-generation applications (transmission cases, clutch housings, intake manifolds, and engine blocks) will continue to evolve rapidly. The second-generation applications (wheels, suspension arms, braking and steering components) got a later start and require higher performance alloys. The Calypso family responds to this need. There again, developments are inevitable in spite of the excess material cost.



Brake caliper pistons made of aluminum. A modest application which manages to save a few grams. (Aluminium Pechiney file photo)



Second-generation applications of aluminum now include mechanical elements such as the suspension arm of the Citroen CX. (Aluminium Pechiney file photo)



A safety part of prime importance, this tandem master cylinder is also made of aluminum alloy. These second-generation applications will continue to develop rapidly. (Photo by Longchamp-Desmarteau)

People are now talking about third-generation applications. This time, the goal is wearing parts (rings of synchronizers, cylinder liners). For that, the French producer is looking to powder metallurgy with Al-Si-graphite lubricant compositions. All these new applications are developing to the detriment of cast metal. "Above all, it is cast iron which will suffer," states Mazodier. The French foundrymen ought to change over to aluminum along the lines of the changes presently taking place in West Germany.

The outlets available in body components on the other hand are very limited. Despite the developments achieved already (the 5182 series satisfactorily accommodates great deformations in stamping), a mass-produced body made of aluminum is out of the question at the present time. Aside from the technical problems (soldering, painting),

the automakers do not wish to bind themselves irrevocably to this metal. Production of aluminum is concentrated in the hands of six giants. Moreover, since its introduction on the London Metal Exchange in 1978, its price has become vulnerable to speculation (even though the volume of trades handled on the London exchange is still very limited). Finally, of all the materials available, aluminum has the highest energy content. At Peugeot they do not have too much faith in it. "As our company sees it, the energy balance is unfavorable."

A passage en masse from sheet steel to sheet aluminum in the automobile is nevertheless conceivable. For that to happen, it would be necessary to create new capacities for thin sheets, where present capacities are clearly insufficient. The Americans are thinking along those lines (in the United States the steel/aluminum price ratio is more favorable). The consequences for the iron and steel industry would be catastrophic.

Another technique which is being discussed more and more concerns the composite or mixed alloys such as aluminum-ABS [acrylonitrile-butadiene-styrene resin]. That material allies the strong points of the individual components; a lightweight sandwich material consisting of three thin sheets is obtained, a metal core 0.6 mm thick with two plastic sheets bonded on either side. The problem is precisely the bonding: it is not known how to complete the bonding quickly. It is also necessary for the expansion coefficients of the components to be compatible. The whole idea is considered unfortunate by the advocates of recycling, who advise against utilization of biconstituent materials of this type because recycling is complicated--if not impossible--and expensive.

Zinc and its alloys also have their role to play. Nevertheless, the producers of Zamak are becoming worried--enough so to have commissioned a comparative study of Zamak versus plastics carried out by ILZRO (International Lead and Zinc Research Organization). The latter supplied data on the mechanical properties of Zamak 3 in comparison to 17 reinforced or unreinforced plastic materials (polypropylenes, polyester, polycarbonate, nylon 6/6, ABS, etc.). Zamak's main advantage lies in its tensile strength and in its constancy with temperature over a range from -40°C to +80°C. It shows superiority in flexural strength, creep properties, and impact resistance under tension or in shear. The economic argument also works to the advantage of the zinc alloys molded under pressure. Their only handicap is that they are more dense--between four and eight times more dense--than the plastic materials.

Copper's position is still tranquil enough, for 5 years at least. The replacement of the wiring harnesses (1.5 km of cables on a Rolls-Royce) by a loop of two or three conductors equipped with electronic pick-offs (multiplexing) is for the moment beyond the reach of the auto industry. The economy of weight is nevertheless attractive. The present harnesses are rendered increasingly complicated--and thus increasingly heavy--by the multiplication of electrical functions (window regulators, rear window wipers, etc.). They often weigh more than 15 kg, but the cost of replacement [with multiplexing] is prohibitive. The first applications will take place on buses. While holding off on multiplexing, the auto industry is increasingly turning to aluminum conductors.

Glass is another item contributing substantial weight to today's cars: on average 3 percent of the weight of the vehicle, or about 30 kg. In the course of the last 20 years, the glass surface area increased by an average of 3 percent per year.

Efforts are in progress to replace it where possible with plastic materials (polycarbonates) and reduce the thickness, the only parameter available to play with. The thickness is presently about 4 mm. The strength of glass decreases as the inverse square of its thickness. Thus a 3-mm pane is approximately twice as fragile as a 4-mm pane. This increased fragility is a handicap both in fabrication and in assembly on the production line. Nonetheless, all glassmakers are offering solutions of this kind (2 mm thickness at Triplex) which sooner or later will find application. Replacement of glass by polycarbonates runs into a different obstacle: insufficient resistance to abrasion. This drawback still prevents use of this plastic on windshields (because of abrasion by windshield wipers under dry conditions). On the other hand, for the side windows, these materials will probably come into use very soon.

Magnesium is still keeping a low profile. Its penetration into the industry is linked to the ratio between its price and that of aluminum. If this ratio approaches 1 (presently it is on the order of 2) as certain observers believe, its uses should take off and amount to 0.7 to 1 percent (about 6 to 9 kg) of each automobile by 1985.

The comeback of steel has been long awaited. Today, it is barely taking form with the arrival of high-elastic-limit steels and high-strength steels. This situation was summarized by G. Hughes, vice-president of Ford Europe, in the course of the last IISI (International Iron and Steel Institute) congress in Madrid in October 1980: "If steel hopes to preserve its present position as a primary material for the automobile industry, it will be necessary that the new generation of high-strength steels be available, and the sooner the better...if the iron and steel industry does not do whatever is necessary to take up these challenges (the new materials), I have the feeling that there will only be one remaining solution: the automobile industry will find the means to adapt itself to some replacement materials." The warning, mainly intended for the European iron and steel industry, is clear and grave.

Today it is known how to make thin sheet metal with a high elastic limit and high strength. The research goal is twofold: render the cars safer in case of impact (better absorption of kinetic energy through deformation) and save weight by reducing the thickness of the sheets. At Renault, this saving has been estimated at about 50 kg for an existing vehicle. In the United States the utilization of a steel rated at 345 MPa leads to a saving on the order of 10 percent on the thickness of the sheet used for a door (0.71 mm instead of 0.83 mm) while maintaining the same strength. According to the prevailing norms, the types of sheet metal presently used have a strength of 340 MPa (max) and an elastic limit of 225 MPa (max), though the actual delivered products have distinctly lower values. Three principal routes are available for obtaining these conventional steels which have some characteristics of special steels.

First one can add a hardening alloying element (phosphorus, manganese, or silicon). These sheet metals are adapted to deep drawing operations. To maintain a satisfactory weldability, the strength is limited to 450 MPa. Next, one can add more of certain dispersoid elements (niobium, titanium, or vanadium). The strength then becomes very high (higher than 800 MPa), but at the expense of ductility. Finally, it is possible to obtain dual phase alloys by rapid cooling with formation of martensitic structure. While the first category is easy to fabricate with the existing means, the other two categories imperatively demand a continuous annealing operation which ensures optimum conditions in terms of economics and quality. Thus in effect there are three families of new steels with complementary properties for different uses.

It is precisely on the matter of continuous annealing that the European iron and steel industry shows the most unmistakable tardiness. This technology dates back to the beginning of the 1970's and was industrialized for the first time by Nippon Steel in 1972 under the name of CAPL (Continuous Annealing and Processing Line). Two installations are being set up in Europe and will be operational this year, one in Sweden (SSAB) and the other in Belgium (Sidmar). Each has a capacity of 500,000 tons/year. Cockerill also intends to equip itself for such operations, as does Hoesch. Not a single installation is being set up in France, nor is any planned.

In the beginning, continuous annealing was developed as a way to improve the productivity of the traditional annealing in coils. The operation, totalling integrated into the line for fabrication of thin sheet metals, takes place in a matter of about 10 minutes instead of several days, and takes place without interruption.

The Japanese (Nippon Steel and Nippon Kokan, respectively number 1 and number 5 in the world) now have a complete mastery of the process and not one installation in the world operates without their know-how and their licenses. They have also furnished samples of sheet metals from industrial installations to most of the automakers.

This delay in outfitting the French iron and steel industry in this sector is unsettling, more especially so as no solution seems forthcoming. "The auto industry is incapable of clearly specifying its intentions, and the iron and steel industry does not have the means to anticipate the needs," remarks one expert. The installations for annealing in coils are already operating at reduced capacity, and the iron and steel industry cannot make a commitment to continuous annealing unless the automakers assure it a market, which is not the case. Considering that several years are required to put equipment of this kind in place, if the French auto industry decides to use these new steels, it will first seek them where they are already available, thus risking accentuation of the imbalance. Once again, it seems that salvation can only come from the state. Again there will be a problem of scale to be solved. Will the eventual beneficiary (Fr 400 million) be Usinor or Sollac?

The time which goes by without decision is not in anyone's interest. Who tomorrow will supply or replace the 600 kg of sheet metal contained in each automobile? At any rate, it will be necessary to choose, and choose well, among a panoply continually being expanded with new or improved materials and increasingly specialized materials.

Eve, Vera, Plume, and the Rest

Peugot's Vera (Experimental Vehicle for Applied Research) uses the 305 model as a base. In comparison to the series-produced version, the weight saving according to the manufacturer's data is around 175 kg, and the average fuel consumption in urban driving is about 6.4 liters/100 km versus 8.4 liters/100 km. The Vera Plus is an improved version of this prototype. The Eco 2000 is a new undertaking for the automaker in conjunction with the government authorities. This will be a small vehicle intended for large-scale production (1,000/day). Its weight is to be on the order of 550 kg and the fuel consumption around 3 liters/100 km in urban driving. The car should go into production around 1990.

Renault's prototype Eve (Elements for an Economy Car) is based on the R 18 but weighs 100 kg less and has an average fuel consumption of 6.2 liters/100 km (against 8

liters/100 km for the series-produced R 18). The Plume (Light Prototype Using Less Energy) is also a project based on improvement of an existing vehicle. The Vesta (Economy Vehicle with Advanced Systems and Technologies) is a project with practically the same specifications as the Eco 2000 and ought to be clearly defined by 1985 and capable of being put in production by 1990.

The Boom in Composites

According to SNIAS [National Industrial Aerospace Company] the French market for composite materials should double between now and 1990. In the next 5 years the automotive applications for composites should increase 40 fold. Presently, the world market is on the order of 135,000 tons for composites based on glass fiber, 1,500 tons for aramid fibers (Kevlar), and 1,500 tons for carbon fibers. The proportion of fibers in relation to the matrix is between 30 and 40 percent.

This matrix can be organic (thermoset or elastomer), inorganic (carbon or ceramic), or even metallic (injected liquid light alloy). The last two categories are only employed in aeronautic or space applications (engine nozzles of the Ariane launch vehicle, fin of the Mirage 4000). At the present time, Japan supplies around 75 percent of the world production of carbon fibers. Two supplemental plants ought to be constructed in Europe before 1985. Kevlar fiber is produced by Du Pont, which is considering construction of a production plant in Europe.

The Irresistible Rise of Plastics at Peugeot. The Eco 2000 Will Not Be Comparable in Size to the 305

		1980	1985	1990
	305	Vera	Vera Plus	Eco 2000
Total weight (kg)	925	750	700	550
Plastics (kg)	74	167	190	250
Composites (kg)	1	67		

Steels for All Tastes

The three processes for hardening steels offer variable ranges of strength, elongation, and ductility as a function of their chemical composition.

The first category of hardening using the solid solution effect (addition of silicon, manganese, or phosphorus) gives a substantial elongation close to 40 percent, a strength in the neighborhood of 500 N/mm^2 , and a modest elastic limit (about 300 N/mm^2).

The second category of precipitation hardening (or formation of microalloys in which the dispersoid elements can be niobium, titanium, or vanadium) gives strengths higher than about 600 N/mm^2 and elongations of about 27 percent. The third category of hardening by transformation (or formation of dual phase alloys) gives the most extended range of utilization and in particular offers the best ductility for a given

strength. These three families find different applications according to the intended purpose (for suitable deformation in case of impact, or for structural parts). They exhibit different surface states, which can pose visual problems of appearance and color.

Basic Characteristics of the Fibers for Composite Materials. Forty Times As Much 5 Years from Now.

	Density (rho) [kg/dm ³]	Breaking strength (R) [MPa]	R/rho	Modulus of elasticity (E) [MPa]	E/rho
Glass fiber (type E)	2.55	3,300	1,290	73,000	28,000
(type S)	2.49	4,400	1,760	87,000	34,900
Kevlar fiber (type 29)	1.44	2,700	1,870	60,000	41,500
(type 49)	1.45	2,600	1,790	130,000	72,500
Carbon fiber (high strength)	1.82	2,300	1,260	210,000	115,000
(high modulus)	1.8 ⁻	2,100	1,130	350,000	187,000

The sheet metals used in the auto industry have thicknesses varying between 0.8 and 1 mm. A change to steels with high mechanical properties enables the thickness to be reduced by about 10 percent. This decrease will necessarily have to be accompanied by a more effective protection against corrosion. Most iron and steel makers already offer solutions of this kind (galvanization on one side, coating with a zinc-aluminum alloy). There is universal interest in limiting the protection layer to a minimum for economic reasons and to avoid contamination of the scrap at the time of recovery.

Pieces of a Puzzle

According to Ford Europe, three parameters intervene in the choice of a material: the density, the thickness equivalence, and the price. The density is favorable to unreinforced plastics (0.9 to 1.1 kg/dm³) which have the advantage over reinforced plastics (1.4 to 2.3), magnesium alloys (1.8), aluminum alloys (2.787 to 2.8), zinc alloys (6.8), cast metal (7.1 to 7.7), and steel (7.82 to 7.87).

Comparing the thickness of material required for a given strength, steel takes the lead (0.9 mm), followed by aluminum (1.1 mm) and reinforced plastics (nylon/glass fiber: 1.3 mm). If the criterion used is the thickness required for a given rigidity, steel comes first (0.9 mm), followed by aluminum (1.3 mm) and the reinforced plastics (2.5 mm).

The 1980 prices favor steel (\$600/ton) followed by zinc (\$800/ton), aluminum (\$1,800/ton), and plastics (\$2,100/ton). The forecasts for 1985 indicate \$900/ton for aluminum and \$3,300/ton for plastics.

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TRANSPORTATION

AUTO MAKERS DISCUSS USE OF PLASTICS AT ANNUAL CONVENTION

Zurich CHEMISCHE RUNDSCHAU in German 13 May 81 pp 1, 2, 5

[Article by Dr of Engineering Heinz Peukert, Glottertal: "Frontiers of Plastics Applications in Automobile Manufacturing"]

[Text] On 23 and 24 March 1981 in Mannheim, about 950 experts from the automobile and plastics industries in Europe and overseas had gathered for the 1981 annual convention of the automobile manufacturers, arranged by the VDI [Association of German Engineers] Plastics Technology Society. The principal theme was "frontiers in plastics applications in automobile manufacturing in the 1980's." Because the altered situation in the energy and raw-material sector in the last decade has resulted in a noticeable effect on the use of plastics in vehicle construction.

Increasing demands for comfort and substantial safety requirements can be met economically only by the use of plastics in many cases, and when there are good chances for large-scale fabrication these plastics bring about a notable advance. It is true that in this connection only the use of thermoplastics has constantly expanded, for developmental, fabricating, and cost reasons. But the hopes for opening up a considerably broader basis of application for plastics in vehicle construction are being subdued by the price increases resulting from price rises for crude oil, problems in connection with introducing such parts to industrial-scale fabrication, or uneconomic production costs because the number of pieces produced is too small. Therefore the dominant theme in the papers read at the convention was not the comments about new developments, but rather questions of whether lightweight construction using plastics is realistic, whether energy savings are economically possible with plastics, or whether the step from technical feasibility to large-scale fabrication is the obstacle to an extensive use of plastics. In an associated exhibition, 24 firms showed mass-produced plastic molded articles for automobile manufacturing, and 8 automobile outfits demonstrated the sensible employment of plastics in various types of vehicles.

Subdued Hopes

In a comprehensive survey of the basic theme, H. Hablitzel argued that hopes for a rapid expansion in the use of plastics are not justified. Paramount in the selection of a material is the achieving of an optimal technical solution, with the following factors being of decisive importance: A technical advance, minimization of costs, optimization of components, and improvement of fabrication.

Moreover, for future developments special attention must be paid not only to a functional optimization of components but also to the principles of long-term usefulness, the recoverability of raw materials, the application of energy-saving techniques for producing and fabricating materials, as well as to the saving of energy in operating the vehicle. The new consideration of the raw-material and energy situation made the outlook for plastics seem to be that of promising materials which can be employed not only in the interior but on the exterior of vehicles as well, and which would have prospects for an application in areas where there is considerable mechanical stressing. In the case of the last-named applications, what is considered above all are glass-fiber reinforced polyesters, reinforced polyurethanes, and the use of carbon-fiber reinforcing, whose technical feasibility has already been demonstrated through numerous developments--entire car bodies and ensemble sections--although the breakthrough here has not yet been achieved. The employment of glass-fiber reinforced plastics (GFP) rose between 1975 and 1978 from 1.9 to 3.6 kilograms per vehicle. In 1979 and in the structurally high-strength sector, 8,000 tons of this material went to bumpers, a figure which corresponds to 54 percent of the total reinforced thermosetting plastics used in automobile manufacturing. The prerequisite for the employment of GFP molded articles does not lie in their development, but in preparing for and carrying out the associated large-scale fabrication.

Without a doubt, a further technical advance in the vehicle sector is being brought about by the use of reinforced polyurethane molded articles, which are fabricated by the RIM technique. With these, one can achieve not only notable weight reductions but also desirable technical improvements such as, among others, corrosion resistance and flexibility in the molded articles, non-susceptibility to shocks and blows, and thereby increased serviceability. However, before they can be used on a large scale the requirement about a cost optimization and fabrication optimization must be satisfied first. On the other hand, because of their economical fabricating in large numbers of pieces, for thermoplastics the breakthrough in automobile manufacturing was already successful in the 1960's. Thus, for example, since 1978 it has been possible to achieve an average increase of about 4 kilograms of thermoplastics per vehicle through the increased employment of modified polypropylenes or thermoplastic ethylene-propylene-terpolymers (EPDM). Moreover, the use of other commercial thermoplastics is increasing continually. An example of this is the rear of the new VW Passat, with a bumper guard made of thermoplastic EPDM and a blow-molded spoiler made out of a thermoplastic (Figure 1). On the same vehicle the sturdily molded door panel is fabricated from sawdust-filled polypropylene (SFPP), which increases the proportion of plastics used by about 3 kilograms/vehicle. Generally speaking, it can be stated that for a number of plastic molded articles for use in automobile manufacturing, their development has moved far ahead of the fabrication capacity, and therefore the input of new technologies is taking place only haltingly.

On the one hand, the fabricating process is not yet able to guarantee the uniform quality which is required in vehicle manufacturing, and on the other hand the fabrication methods and their automation have not been perfected to such an extent that an economical fabrication exists as yet. The introduction of new plastics applications into production requires a great deal of time. In doing this, if competitiveness vis-a-vis other customary materials is to be

preserved, then given the higher material costs component to be expected for molded plastic articles the fabrication costs must be lowered--that is, productivity must be raised through automation. Of course, here the complete fabrication of the subassemblies must be incorporated into this automation.

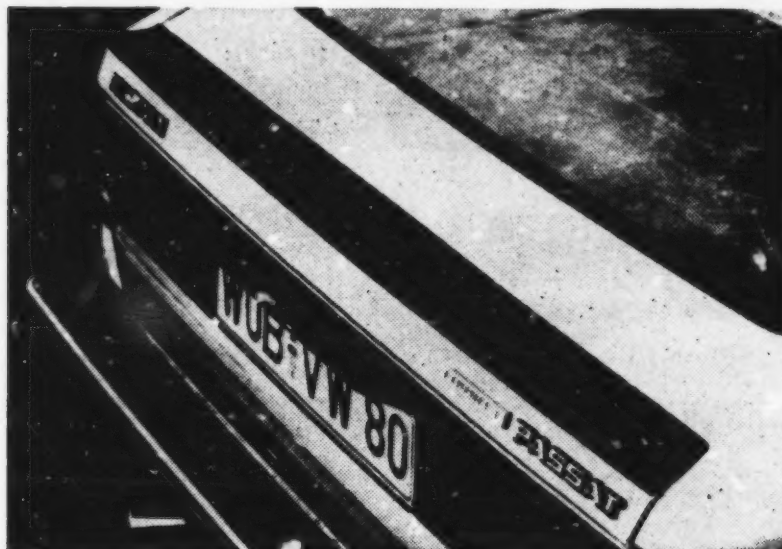


Figure 1. Spoiler Made From a Thermoplastic by Blow Molding. Absolute added weight: 0.685 kilograms/vehicle. By improving the c_w value, a saving of gasoline which corresponds to a weight reduction of the vehicle by about 23.5 kilograms.

Research and Production Associations

A highly developed automation and the associated substantial raising of productivity and economical fabrication has enabled the Japanese to press forward in automobile manufacturing (Figure 2). In the coming years, decisive efforts are in store for the automobile industry in this area--efforts which will require capital expenditures amounting to billions of marks. In order to keep the cost-intensive development of equipment for raising production within tolerable bounds for the individual vehicle manufacturers, European and American firms have teamed up to form research and production associations. Contacts have been entered into with Japanese businesses as well. Figure 3 shows the interlinking of the automobile concerns, with the objective of increasing efficiency and productivity through a linked and joint production.

These joint efforts for the purpose of raising productivity should be contemplated by the plastics industry as well. But various prerequisites must be provided if these efforts are to materialize, such as a coordination between

the large-scale chemical industry as the raw-material producer and the mostly small-scale industry which processes the plastics, and the modifying of the purchasing strategy of the vehicle manufacturers. Here also, rationalization measures for the sake of large-scale production will undoubtedly require considerable capital expenditures.

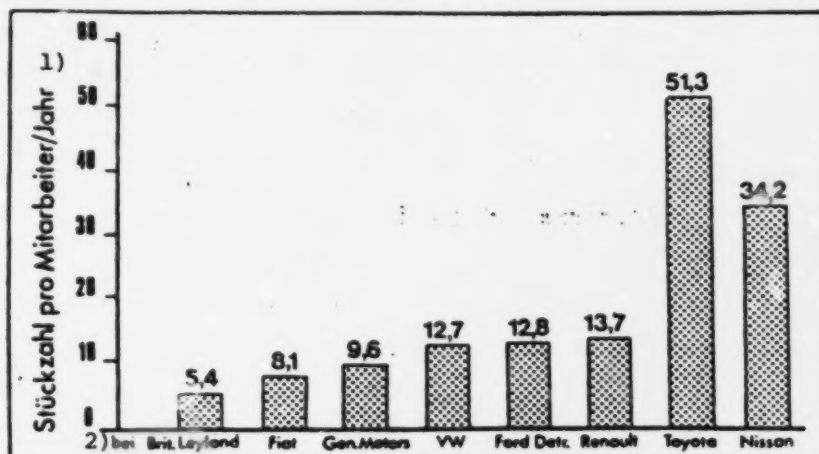


Figure 2. International Comparison of Production, 1979. Produced vehicles per employee and year for European, American, and Japanese automobile manufacturers.

Key: 1. Number of pieces per employee/year
2. At

According to K. D. Johnke, the trend toward lightweight construction in the automobile industry for non-load-bearing components is continuing to be realized by the use of plastics and suitable light metals. It is not yet easy to assess to what extent reinforced plastics are also replacing the customary materials in the sphere of highly stressable parts, especially since frequently new concepts and developments in automobile manufacturing are sparked by these new types of material. Because these composite plastics are associated with an elaborate automobile design and the resulting requirements for applications in vehicle manufacturing. In Europe, this plastics constituent lies between 40 and 100 kilograms per vehicle at present.

For fiber-reinforced composite plastics there are various matrix and reinforcing materials as well as diverse procedures available which can be selected and combined on the basis of designed loads and according to function. In this way the differing and to some extent even opposing criteria in the designing of a vehicle, as well as all legal requirements which are placed on a car body and on the exterior of vehicles, can be satisfied. But since the legal requirements are only general for the most part and not related to a specific material, the vehicle manufacturers should draw up uniform and suitable material specifications for the entire automobile industry based on practically oriented qualification profiles.

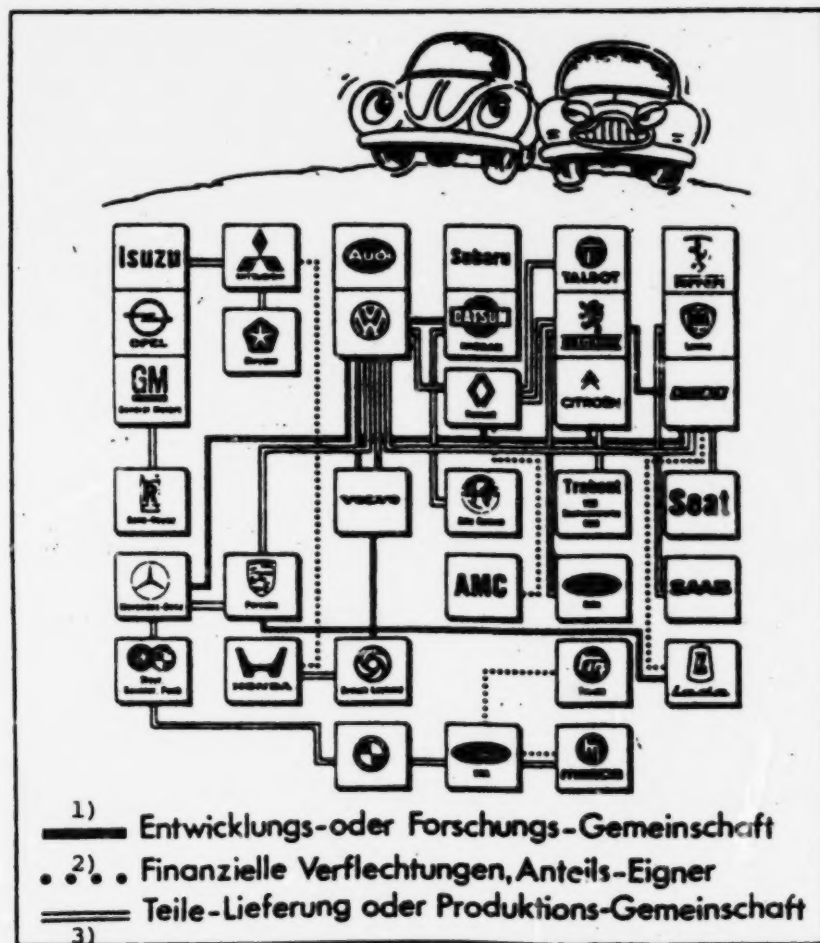


Figure 3. Interlinking of the International Automobile Concerns

Key: 1. Development or research association
 2. Financial links, shareholders
 3. Parts supplying or production association

Competition Based on Substitutes

In the substitution competition against conventional, hitherto employed materials, the future development of prototypes will have to come to grips with technically feasible automobile parts made of fiber-reinforced composite plastics, such as leaf and spiral springs, frameworks, door side stabilizers, roll bars, and also chassis-unit parts, turbine rotors, or clutches. At the same time, the suitable process techniques for a large-scale production must be worked out. Furthermore, in this area consideration must be given not only to a functional

optimization of components but also to the principles of a long-term maintenance of value of components, a capacity for recycling, and the use of energy-saving procedures in producing and fabricating the materials. An economical processing cycle is absolutely essential for a large-scale use of SMC [expansion unknown] types and resin-impregnated mats for functional molded articles in vehicle manufacture, with such a cycle extending from the program-controlled production of the initial material, past its manufacturing by mechanical processes, to the molding cycle and from there into the finishing and enameling stages. In this connection, the enameling of car-body components is still causing difficulties above all, since such an enameling must meet exacting visual standards in accordance with the inspection specifications of the automobile manufacturer and since it is measured by the standards for a sheet-metal enameling. In order to measure up to these standards, extensive developmental work is still necessary, because on the one hand it is difficult to produce GF-UP molded articles with a pore-free surface by the SMC process, and on the other hand even with the use of primers suitable to the material and a subsequent enameling, the pores are not completely closed and eliminated. But this means that considerable retouching work must be done, which involves corresponding costs. High polymers offer also manifold and often novel possibilities in the sector of noise control, whereby they furnish an effective contribution to environmental protection through sound insulation and absorption. A convincing example of this is the noise-screening jacket made of GFP for the diesel engine of the VW Passat, with an integrated recess for the horn, with which not only could the weight be lowered compared to the steel jacket, from 3.3 kilograms to 2.1 kilograms, but also the manufacturing costs could be reduced by 43 percent.

Plastic Car Bodies

The fabrication of complete plastic car bodies on an industrial scale will also continue to remain limited to prototype and small-scale manufacturing because the mechanization possibilities are too restricted and because of the additional space requirements for the curing process (Figure 4). Surely a quantity-produced complete plastic car body will continue to remain the exception.

However, for research purposes industry is continuously developing and testing extremely lightweight car bodies which help to save energy because of their small weight and low air resistance. With such developmental vehicles, a detailed insight is to be gained into the connections between the aerodynamics of an automobile, weight reduction, and fuel consumption. To what extent these developments have been advanced is shown by the results of the turbo-diesel vehicle C 111 of Daimler-Benz, and recently by the test runs of the ARVW (Aerodynamic Research Volkswagen). The demands placed on these vehicle car bodies could be satisfied only by a composite plastic with an extremely light and at the same time highly stressable laminated construction. This car-body shell, produced by the hand-laminating process, consists of a novel laminate construction, a combination of aluminum and fiber-reinforced UP resin, whereby on the one hand an optimal designing was achieved in accordance with aerodynamic principles, and on the other hand the desired stability was obtained with a wall thickness of only 1.8 millimeters--that is, by the lightweight construction method.

				
1) Modell Hersteller	2) Land	3) Stückzahl pro Jahr	4) Werkstoff - Konzeption	5) Aufbau
Alpine Renault	7) F	1380	8) GFK-Außenhaut	9) Zentralrahmenchassis mit Stahlüberrollbügel
Corvette Chevrolet	USA	49000	8) GFK-Außenhaut	10) Kastenrahmen mit Traversen
Esprit etc. Lotus	GB	1030	8) GFK-Außenhaut	11) Gitterrohrrahmen
Murena Talbot	F	5700	8) GFK-Außenhaut	12) Selbsttrag. Stahngerippe tiefgez. Blech m. Hüllrahmen
Puma GTE VW do Brasil	Bras.	3610	8) GFK-Außenhaut	13) Zentralrohrrahmen
Kitten/Scimitar Reliant	GB	820	8) GFK-Außenhaut	14) Profilsienrahmen Kastenr. mit Traversen
Trabant Sachsenring/Zwickau	DDR	120000	Baumwolverst. Phenolharz 16) "Duromerschale"	15) Plattform und Gerippe
Mach1 BMW	D	380	8) GFK-Außenhaut	11) Gitterrohrrahmen

Figure 4. Plastic Car Bodies and Their Structural Design

- Key:
1. Model, manufacturer
 2. Country
 3. Number of pieces per year
 4. Material-design
 5. Body
 6. Frame
 7. [in descending order:] France, United States, Great Britain, France, Brazil, Great Britain, GDR, FRG
 8. GFP shell
 9. Central-frame chassis with steel roll bars
 10. Box frame with crossbeams
 11. Tubular grid frame
 12. Selfsupporting steel framework, deep-drawn metal sheeting with subframe
 13. Central tubular frame
 14. Sectional-iron frame, box frame with crossbeams
 15. Platform and framework
 16. Cotton-reinforced phenolic resin, "Duromer Shell"

In summary, it can be stated that both fiber-reinforced thermosetting plastics and fiber-reinforced thermoplastics are trend-setting materials with a logical utilization for automobile manufacturing, and that in particular SMC materials having a large or oriented fiber content will find new employment possibilities in vehicle construction.

Plastics Percentage Unsatisfactory

The increase in the plastics constituent in vehicle manufacturing is quite satisfactory, according to G. Walter; it reaches 7.3 percent in the new Mercedes-Benz passenger-car model series of the S class. In this connection, up to now four fifths of the plastics applications have been concentrated predominantly on the car interior, and only a limited amount has been used for car-body components. Occupying second place, on account of their pronounced electrical insulation properties, are plastics applications in the automobile electrical system. On the other hand, in the various units such as engine, chassis unit, and transmission, hitherto only few plastics parts have been used.

The employment of plastics as structural materials in automobile manufacturing was set forth by way of exhibiting various functional plastic parts, and the corresponding structural and material standards were explained. A general view of successful large-scale applications of plastics for functionally important components is given in Table 1. It is clear from this list that primarily high-grade, mostly fiber-reinforced thermoplastics and thermosetting plastics are being used. In this connection, as a rule new plastics are first introduced in passenger cars, and are then tried in utility vehicles after some large-scale trials under the most difficult of conditions. It is assumed that for an intermediate-sized van the plastics use is about 80 kilograms on the average, and for a 40-seater bus it is about 280 kilograms because of the large area devoted to interior accommodations. Another functional component which because of its pattern of properties contributes considerably to functional safety and a long service life is the cooling fan. The prospects and developmental emphases for further applications of plastics are listed in Table 2. According to this, fiber-reinforced, force-distributing, fracture-resistant, and cushioning plastics are coming into use above all. Here, the fiber-reinforced plastics are at the center of interest for use as mechanically and thermally highly-stressed plastic parts. But in order for numerous new possibilities to be opened to them as structural materials, the development of production methods and component designing and testing in interaction with all the different testing mechanisms is needed to reach the stage of mass production. Aside from these technical difficulties, the industry is still faced with not very encouraging economic prospects with respect to price developments. Therefore the introduction of further applications of plastics to quantity production in the vehicle industry continues to require a great deal of commitment and consciousness of the problems involved.

Aircraft Manufacturing

D. Schutz provided a glance on the other side of the fence with his comments on the application of fiber-reinforced plastics in civilian aircraft manufacture. The use of these composite plastics is mainly for the purpose of reducing structural weight and thereby saving on fuel costs in connection with modern passenger aircraft. Starting from more than 15 years of experience with the employment of conventional glass-fiber reinforced plastics (GFRP) and a fundamental technological knowledge in the areas of the design and fabrication of modern fiber composites, from 1976 on the development of weight-saving secondary components from modern fiber composites was undertaken in connection

with the redesigning of the smaller Airbus A 310. Aramide-fiber reinforced (SFP) and carbon-fiber reinforced (CFP) plastics as well as their hybrid are being processed in connection with the fabricating of spoilers, rudders, nose parts, landing-gear flaps, and fairing parts. The employment of these rigid, high-strength composite plastics allows a weight reduction of about 20 percent compared to the conventional lightweight-metal components. After several years of successful operational testing, these components are to be used in quantity from 1983 on. The manufacturing of the first Airbus rudder out of carbon-fiber reinforced plastics represents another basic developmental step. This moveable tail-assembly part, which is 8.3 meters high, is constructed according to the sandwich-panel design, since by this means it could conform best to the design specifications. To be sure, this structural design does not allow the maximum weight reduction, but it does allow instead a more cost-favorable fabrication. This rudder, which is currently the largest CFP aircraft component in Europe, is now starting to be operationally tested on an Airbus of Deutsche Lufthansa. With that, MBB [Messerschmitt-Boelkow-Blohm GmbH] has come considerably closer to the goal of having the capacity, by the middle of the 1980's, to fabricate the entire Airbus rudder unit, currently weighing just under 1.2 tons, out of modern fiber composites, which will make it about 20 percent lighter and more economical. This rudder unit, as the first fiber component of a primary structure for the Airbus, will thus take on a fundamental significance for civilian aircraft manufacturing. Because in the last analysis the information on construction, fabrication, and quality gained in the redesigning of the rudder was responsible for the fact that the development of the load-bearing rudder-unit body was undertaken with fiber composites. Such a component is to be delivered to Deutsche Lufthansa for putting into commission by 1985. By the example of this intermediate rudder-unit body, ultimately the proof is to be furnished that the use of modern composite plastics for load-bearing aircraft structures is a suitable step for lowering operational costs without endangering safety.

Through continuous research and development in the area of fiber-composites technology, it is expected that by the year 2000 fiber composites will be used as the primary material for almost all structural components of the passenger aircraft. In doing this, the result for an airplane of the size of the A 310 would be a reduction in mass of about 6,000 kilograms. Given the present cost and price situation and for an airline with a fleet of 20 aircraft of this type, this would lead to an annual cost savings of about DM 45 million.

Table 1. Large-scale Plastics Applications With Functionally Important Components. (+): Application limited to single types or to an initial mass-production phase.

<u>Component</u>	<u>Plastics used</u>	<u>Application with</u>		
		<u>Car</u>	<u>Van</u>	<u>Bus</u>
Hood	Polyester GFP (UP-GF)	-	Unimog	-
Bumper supports	UP-GF	(+)	-	-
Distributor cap				
Distributor rotor	Polyester molded material	+	-	-
Spark-plug terminal				
Fan for the radiator	Polyamide 6/glass-fiber reinforced (PA 6 GF)	(+)	(+)	-
Radiator tank	PA 66 GF	+	(+)	-
Bearing cages	PA 66 or PA 66 GF	+	+	+
Suspension frame, electrical system	PA GF or polycarbonate GF	+	+	+
Wheel shield	PA 6 GF enameled	+		
Slide rails for camshaft chain	PA 66, heat-stabilized	+	-	-
Tubes for compressed air, fuel, oil, suction	Polyamide 11, 12 (6)	+	+	(+)
Radiator grill	Polyamide, polypropylene			
	ABS, glass-fiber reinforced	+	+	-
Fan cowls	Polypropylene, talcum-filled	+	+	-
Air ducts, tubes, hoses	Polypropylene, polyethylene hard (PE)	+	+	+
Cooling-water header tank	Polypropylene (PP)	+	+	+
Accelerator pedal with integrated film hinge	Polypropylene	+	+	+
Bushings and the like	Polyacetal (POM), polyurethane	+	+	+
Fuel tank	Special polyethylene, hard	(+)	(+)	-
Gaskets in the power steering, automatic transmission	Polytetrafluor ethylene (PTFE) compounds	+	+	+
Operating handles	POM, PA, PP, PE, ABS	+	+	+

Table 2. Developmental Emphases of Further Plastics Applications

<u>Goal</u>	<u>Aimed at by using</u>
Weight reduction	Fiber-reinforced plastics for car body and functional components (in addition to other lightweight construction materials)
Safety	Cushioning, force-distributing, and fracture-resistant plastics
Economy	Materials/components with favorable total costs (price of materials, manufacturing, installation)
Noise deadening	Materials which contribute to the reduction of noise generation and radiation
Alternative fuels	Materials which are unaffected by alternative and conventional fuels
Comfort/styling	Materials which correspond to demands specific to particular vehicles

RRIM Technology

In the opinion of D. F. Gentle, in the near future most of the innovations in the area of plastics applications in automobile manufacturing will occur in the field of RRIM technology, where not only polyurethanes but also non-polyurethanes will come into use. In the United States, for the RRIM technology the PUR [polyurethane] materials are divided into four groups on the basis of their typical [elastic] modulus ranges, which in turn have ranges for unreinforced and reinforced material (Table 3). But in order to be able to introduce an optimal material for RRIM exterior parts, extremely intensive developmental work is still needed both on the material itself and on the material treatment and the fabrication process. Among other things, RIM materials must be developed which combine a high dimensional stability at 204°C with good impact-strength properties and which provide molded articles which are free of sink marks. Moreover, fabrication techniques must be developed which allow the fixation of the fiber mats in the mold cavity during the injection of the RIM material at the prescribed place.

Table 3. Designations and Classification of RIM and RRIM Materials.

Material designation		Reinforcing additive %	Typical flexure elastic [E] modulus range N/mm^2	Sample thickness mm	Specific-weight range kg/m^3	Typical applications
A	RIM with low E-modulus	-	35-350	≤ 3.2	870	Dashboard
B	RIM reinforced, with low E-modulus	5-30	70-560	≤ 3.2	950-1135	Dashboard
A	RIM quick-acting, with intermediate E-modulus	-	35-490	≤ 3.2	870	Undecided
B	RIM quick-acting, reinforced, with intermediate E-modulus	5-30	700-980	≤ 3.2	950-1135	Fender, fender reinforcements, spoilers
A	RIM with high E-modulus	-	700-2450	≤ 3.2	870	
B	RIM reinforced, with high E-modulus	5-30	1400-5250	≤ 3.2	950-1135	Fender, trunk, hood
A	RIM, hard (structural fomed plastics)	-	420-840	≤ 12.7	420-560	Undecided
B	RIM, hard, reinforced	5-30	480-1680	≤ 12.7	630-930	Hood, trunk lid

RIM made of non-polyurethane

Values are to be determined according to the availability of these materials

In the course of the convention it was emphasized several times that the reducing of the c_w value--that is, the designing of the outer shape of the automobile--is of decisive importance to a saving of energy in operating the vehicle. Using the example of the Medusa, a sporty sedan with an intermediate-sized engine and with the mechanics of the Lancia Beta Montecarlo (Figure 5), with a c_w value of only 0.263, H. Giugiaro made various noteworthy suggestions. He stressed in his commentary on this that a number of these requirements for a c_w -value reduction can be realized economically only by using plastics.



Figure 5. Medusa (prototype) of Italian Design. Sporty sedan developed according to aerodynamic criteria.

In other papers, the employment of plastics for various components was discussed, and moreover expression was given to the view that the range of plastics available today offers such manifold possibilities that with a selective choice of material the safety and performance regulations as well as the economic requirements can be satisfied. Moreover, the development of new process techniques also will allow a mass production of exterior parts.

The lively, to some extent even controversial discussion revealed once more the relevance of the topics chosen, but at the same time made it clear also that an important role falls to plastics as structural materials in the task of fulfilling the future requirements of automobile manufacturing. But it also showed that extensive developmental work is still necessary in order to satisfy the demands which will be placed on these materials. Here, the fabrication technology takes on a primary importance as well, since it must be integrated in a trouble-free way into the large-scale production of the vehicle industry. It was stressed again and again at the convention that all these problems can be solved only through a close and concerted cooperation between the plastics and automobile industries.

12114

CSO: 3102/329

TRANSPORTATION

BRIEFS

METHANOL BUS IN BERLIN--In Berlin the MAN AG (Augsburg) has handed over a city bus with an alcohol-powered engine for use in regular service. It is the first bus from MAN which can be run on pure, undiluted alcohol. Assurances are given that the engine is as economical in consumption as a diesel, gives off only extremely "low levels of toxic emissions and operates completely soot-free." It is based on an already proven six-cylinder MAN diesel, but is equipped with an additional ignition system and a modified combustion chamber. Ignition takes place by means of spark plugs. For compression ignition the compression ratio would have had to be raised so high that the components would have been mechanically overstressed. As a result of the ancillary ignition system the compression ratio remains the same as in the diesel engine. The typical diesel cold-starting problems are absent, and preheating devices are not needed, in the company's opinion. However, the volume of the fuel tank had to be doubled in order to achieve about the same operating range as with a diesel motor; methanol attains only just half the figure of a diesel. In the view of MAN, methanol, which can be derived chemically from coal and natural gas, is close to being economical, in view of rapidly climbing fuel prices. [Text] [Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 23 Jul 81 p 7] 9581

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West Europe Report

SCIENCE AND TECHNOLOGY

No. 74



FOREIGN BROADCAST INFORMATION SERVICE

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BIOTECHNOLOGY

BRIEFS

INTERFERON FROM BACILLUS SUBTILIS--Researchers at the biotechnology company Biogen SA in Geneva have successfully manufactured human leucocyte-interferon by genetic manipulation from families of the bacterium *Bacillus subtilis*. In addition they cultivated families of the same *Bacillus*, which produce antigen proteins of the viruses which are responsible for Hepatitis B and foot-and-mouth disease. The development work was carried out in part together with the Centre for Applied Microbiology of the Public Health Laboratory Services at Porton in England. The researchers at Biogen announced some time ago the first manufacture of these products from bacterial families of *Escherichia coli* (*E. coli*). In contrast to *E. coli*, *B. subtilis* has a number of advantages with respect to the industrial manufacture of products of human or viral genes. For example, *B. subtilis* does not form any febrifacient endotoxins and can be manufactured more easily in large quantities. Since this bacterium is already in widespread use for the commercial production of enzymes, amino acids and antibiotics, it is of great interest as an alternative organism for the manufacture of proteins such as, for example, interferon. The derivation of leucocyte-interferon from *E. coli*, developed by Biogen with the Schering Corp., is already at an advanced stage. Clinical tests are planned for this year. [Text] [Duesseldorf EUROPA CHEMIE in German No 15, May 81 p 256] 9581

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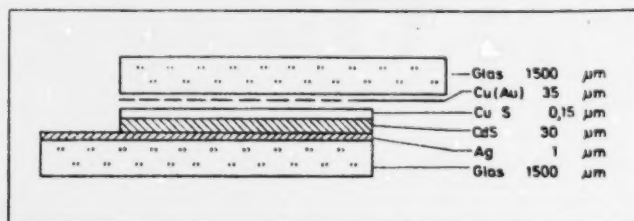
ENERGY

THIN-LAYER SOLAR CELLS DEVELOPED AT STUTTGART UNIVERSITY

Wuerzburg ELEKTROTECHNIK in German 29 June 91 pp 12, 14

[Article: "Generators Made from Thin-Film Solar Cells"]

[Text] Among thin-film solar cells, the $\text{Cu}_2\text{-CdS}$ cell is the most highly developed. With large-area cells of this type efficiencies of 8 percent have been achieved at the Institute for Physical Electronics at Stuttgart University. The process developed there for producing large-area $\text{Cu}_2\text{-CdS}$ cells is based on low-cost processing steps such as high-vacuum vaporization, chemical conversion in an immersion bath, silk-screen printing, etching and galvanic deposition. This makes possible the production of single cells of any desired size and integrated modules on a common substrate with a common covering glass.



The glass upper surface required for long-life solar cells or modules is in this construction, see figure, an integral component of the solar cell or module. The result is a glass-glass sandwich structure which combines high mechanical stability and high resistance to weathering. Add-on base and cover glasses are no longer required.

With an area of 30 by 15 cm and an input power ratio of 100 mW/cm^2 , integrated modules for 3 or 6 volts out have an output power of about 1.5 W. Ratioed on the active area, this corresponds to an efficiency of 5 percent. The process developed at the Institute has been taken over by Nuken at Hanau where a pilot plant is presently being set up.

9160

CSO: 3102/386

ENERGY

SIEMENS COMBINES WIND POWER WITH SOLAR CELLS, BATTERIES

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 4 Aug 81
p 5

[Article: "Energy Concept for Small Users"]

[Text] Siemens AG, Munich/Berlin. A noteworthy concept for the independent generation of electricity for small consumption stations has been further developed by Siemens. An example is the energy supply for a TV relay transmitter in Austria. By combining a solar panel and a wind generator to jointly charge a battery, a fully autonomous mode of operation is achieved, according to Siemens. This concept, which is ideal for remote locations, is so designed that a converter can still operate even when there is no sun or wind for a whole week.

The joint energy supply for the TV relay operates automatically in the following manner: The direct current generated by solar radiation in 4 solar panels is fed via a "Sipmos" controller directly to the relay. The panels are connected in series-parallel and provide 24 volts operating voltage at 12 volts per panel. The wind generator produces alternating current with a voltage of 40 to 220 volts, depending on wind velocity. A microprocessor-operated controller varies the turning speed of the generator to achieve optimal power output and connects and disconnects the load. A fuse prevents system damage during a storm. The dc (charge) converter with a high internal efficiency effects rectification and battery charging. The wind-generator blades are designed with diameters of 2 or 3 m depending on power requirements.

The Siemens generators are lee runners--the erection of the blades in line with the wind is accomplished by a ram-jet tube. The specified rated power is 150 W at a wind speed of 5.9 m/s with 2-m blades and 350 W with 3-m blades. At a wind speed of about 1 m/s the blades begin to rotate, and beyond about 4.4 m/s the generator starts delivering power. In developing the solar/wind TV relay, the Austrian Siemens engineers achieved even further economies. Modifications to the 1-W TV relay made it possible to significantly reduce energy consumption, a task which was considerably simplified by the modular construction. When transmitting, the standard design consumes 65 VA while the economical version requires only 40 VA, thus only 2/3 as much. When not transmitting, the modified relay consumes only half as much power as the standard version, reports Siemens.

9160

CSO: 3102/383

ENERGY

SIEMENS EXHIBITS THIN-LAYER AMORPHOUS SILICON SOLAR CELLS

Wuerzburg ELECTROTECHNIK in German 29 Jun 81 pp 10, 11

[Text] Polycrystalline silicon is without competition as a starting material for many electronic components but is presently still much too expensive to make a significant contribution to the energy supply when used in photovoltaic solar cells. Hopes are thus placed on amorphous silicon which could lower the price of solar cells from today's level of about \$50 per watt to possibly \$0.50 per watt. At this year's Hannover Fair, Siemens exhibited in its special show "Impulses for Growth Innovations" a type of solar cell with especially thin--and thus material saving--amorphous encapsulation. As in the case of crystalline silicon, the current generating n-p junction can also be produced by doping hydrogen-containing, amorphous silicon. The starting material is produced rather cheaply and with low energy expenditure by decomposing silicon hydride SiH_4 via the corona discharge process. The amorphous silicon produced this way promises efficiencies of from 10 to 20 percent and could also provide the thrust for other semiconductor developments. New thin-film transistors (TFT) are already under consideration. Cell efficiencies achieved to date in the laboratory are in the neighborhood of 5 to 6 percent.

By the corona discharge process being researched at Siemens, silicon can be deposited in such thin films ($1\mu\text{m}$) that the cost of the actual semiconductor for solar-cell use is much less than the cost of the substrate. The manufacturer is researching cheap substrates made of steel sheet or plastic foils which are suitable for continuous strips or tapes.

According to preliminary estimates, photovoltaic solar cells for large-scale use could be produced with amorphous silicon which would be up to 100 times cheaper than those made from conventional single-crystal silicon. The price and efficiency of these cells would then lead to competitive energy production costs.

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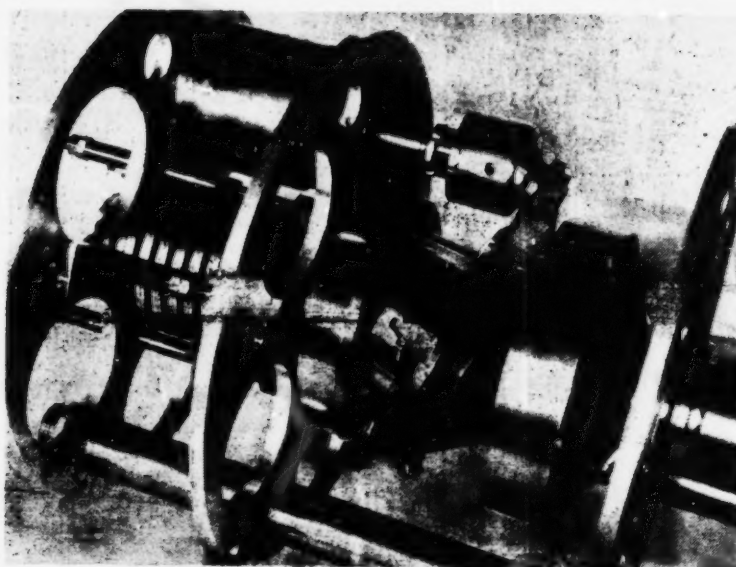
CSO: 3102/386

BRIEFS

ORGANIC TRANSISTOR DEVELOPED--Using a mothball-like material, scientists at the University of Durham in northwest England have developed an organic transistor, probably the world's first. It is based on a thin-film process pioneered by the American scientist Langmuir in 1935. He had discovered that an organic film one molecule thick could be produced by floating the material on a suitable liquid. With a refined version of the Langmuir basin, the British researchers were able to produce an organic film with a thickness of only $1/1000 \mu\text{m}$. For this they used anthracene which is closely related to naphthalene, the material from which mothballs are made. [Text] [Wuerzburg ELEKTROTECHNIK in German 9 Jun 81 p 5] 9160

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5



This view of the first manual model for kinetic verification, equipped with a single piston rod, clearly shows the simplicity of the Brille system design.

none of them is really effective. On the other hand, the only solution based on a conical geometry (rather than on a spherical one), proposed by Brille and recognized as original by the La Haye International Patents Institute, makes it possible to replace pure sliding with a nearly pure rolling motion, with excellent efficiency.

In this axial engine, the dish attached to the piston rods acquires a simple vertical back-and-forth motion at its outer edges (the cylinder axis is considered as vertical in drawings 1 and 2): the shallow part of the dish, point 2 of drawing 1 and point 7 of drawing 2, traces an approximate circle that can be utilized by the crankshaft.

The cleverness of the system is that it pivots around a virtual point S (figure 2), thanks to a group of crowns with large teeth, which block the up-and-down motion of the system as the teeth brace laterally against a rail for a perfectly circular drive. While it might be difficult to intellectually digest this solution, it appears very simple as soon as it is seen. Four large toothed crowns alternately approach each other without ever turning: a sheet of paper inserted between their teeth demonstrates the total absence of sliding, which is replaced by rotation.

All Is Ready

The quality of the preliminary work has drawn attention to the Brille engine. ANVAR (National Agency for Implementation of Research) and DGRST (General Delegation for Scientific and Technical Research) have lent their support to the project: the original calculations were thus rerun and perfected on a computer, and many students at Arts et Metiers have developed a great interest in this problem. A working

INDUSTRIAL TECHNOLOGY

EXPANSION OF ROBOT INDUSTRY TO FOREIGN MARKETS

Comau's Automation Methods

Milan SUCCESSO in Italian Jul-Aug 81 pp 37-38, 41

[Article: "Turin, Capital of Europe"]

[Text] It is a well known fact that the American auto industry has had to deal with a crisis of devastating proportions in recent years. Not so well known is the fact that, in order to survive, Ford, General Motors and Chrysler are modernizing their production organization by acquiring technology from Europe and Japan. Among the countries today in a position to sell new machines and advanced production systems, one finds Italy. How come? Because our country is in the vanguard of the field that counts the most: that of automation.

Only 15 years ago, all this would have been unthinkable. But since then things have changed. The oil crisis has rekindled discussions dealing with the entire system of transportation, individual and collective, and has imposed continuous revisions of target quotas by manufacturing concerns. Throughout the whole world, the problem of managing large auto plants has arisen, a process under constant pressure from unions. A crisis which has lasted a few short years has effectively managed to disable a rigid and vulnerable production system, one that was incapable of adapting to the sharp changes of a fickle market, paralyzed by the increasing intolerance of workers, who rebel against dangerous working conditions, conditions that are characterized by repetitiveness and lacking in professional content.

But, paradoxically, it was in those very countries where the crisis was most keenly felt that these new avenues have appeared. Among these countries one finds Italy, where for some time automation has been viewed as a new, fundamental prospect for the auto industry. It is viewed as a kind of necessary choice which finds its justification in a word that has almost magic qualities: flexibility. Flexibility in production organization, flexibility in choice of various market conditions, flexibility in face of increasingly uncertain economic cycles.

There is a company in Turin that has become a symbol of sorts of this worldwide transformation. Its name is Comau and its recent history includes a whole series of diversified interests: one can talk of it as a traditional family album,

linked to the history of Italy's automobile capital, one that was suddenly "married" with one of the most forward-looking facets of the industry, that of automation and industrial robots. Comau was established in 1977 when a group of old manufacturing companies making machine tools, working alongside the larger FIAT combine, formed, from a consortium, a new integrated company bringing together about 10 manufacturing plants, 6,000 employees and a base capital of 300 million dollars. The 1970s were years of uncertainty for machine tool manufacture until the signals emanating from the auto industry became clear. The final word then was: one must change. From a whole series of industries specializing in the manufacture of the most common means of production, machine tools, "the new method of making automobiles" had to emerge. Everyone, industrialists, politicians, union leaders and sociologists were talking about it. This is what they are attempting to do at Comau, and what is more, they benefit from the availability of an essential laboratory nearby in the great FIAT plants in which to test their innovations.

In just a few years integrated systems for production were made, replacing old machinery and the old assembly lines. At the base of the new systems are the wonders of data processing: finding the welding spot using computers and more advanced machine tools, they create something completely new: industrial robots. And by putting everything under the control of a series of computers, which program times and movements, the philosophy of automation has begun to take shape and has started entering the automobile industry's assembly plants.

In order to understand the extent of this innovation, it is necessary to see it at first hand. Probably the most spectacular of the systems created by Comau is the Robogate, a name that is known around the world because of its adoption, not only by FIAT, but SEAT of Spain, Citroen, Chrysler and General Motors. What is Robogate? It is a completely automatic unit that performs all spot welding operations on a car chassis. The chassis mover, which used to hang over the welders' heads, now moves past a battery of robots that weld joints in rapid succession. The robots, that look like elongated arms, capable of various articulated movements, are lined up on both sides of the car chassis mover. As it passes, the arms reach into the car and weld the programed spots with an almost natural elegance. When the mover exits the various stations where the robots are found, the welding process will be completed. Who regulates the whole process? It is a central computer that controls the cars' movement from one station to another, establishes the timetables, keeps track of stocks and supplies and controls the other computers inside each robot.

In other words, the whole working phase is done without manpower and assigned to automatons coordinated by an artificial brain. Most probably this machine will pass into history. Robogate will become as famous as the Jenny, the power loom that ushered in a new era in the history of modern industry. "The spot welding robot," Comau officials explain, "is in effect a revolutionary machine, one of the high points to be attained by second generation robots. But this is not the most important function we perform here. The essential aspect of our work is the connecting of these machines: the result is more than an automaton that performs an unpleasant task for man, but rather it is a system, an integrated, automatic unit. This is the principle that will regulate future manufacturing plants."

To make this automatic process function, only a small number of specialized technicians is necessary. At General Motors, where about 3,000 robots will be installed, plans call for a 50-percent reduction in body work personnel over the next 10 years. But it is not really the prospect of less labor used in manufacturing that acts as a catalyst for the introduction of systems such as Robogate. The real novelty of the system is the plant's flexible nature, which is much more adaptable to the demands of an uncertain market such as the present one.

There was a time when fixed assembly lines shut down for the summer recess to retool for production of new models. The great plants changed production lines in consonance with foreseeable cycles. Depreciation allowances were calculated to within acceptable margins of certainty. This situation no longer holds. The era when large stocks were gradually depleted to make room for a new product has come to an end. Today large automobile manufacturers need ever more flexible plants able to diversify; car models have multiplied and even single models have differing characteristics. The well known aspect of personalizing a car both fascinates and snares the consumer, but costs the manufacturer money.

The old assembly lines are not able to satisfy these needs for versatility, and it is here that automatic, flexible systems come into their own. A welding line such as that of the Robogate can easily be adapted to produce 10 different models. The computer will program the necessary cycle for the initial work phase, sending coded information to the various robots.

From bodywork to engine building: at Comau, a new integrated assembly system called "asynchronous" has been built. This is due to the fact that employees, instead of working on one assembly line following a given speed, work in operational groups, one separate from the other. Carts carrying engines are conveyed automatically from one part of the department to the other by computer. Between stations, storage areas assure that the system does not jam or get overloaded. A system of this type can be applied not only to the auto industry, but also to TV or refrigerator manufacturers. "Our secret," explained Paolo Cigna director of the automation division of Comau, "is to know how to combine diverse techniques and experiences. We perform well mechanically, because we have been building machinery used by the mammoth auto industry for decades. We have learned how to apply the most sophisticated software to these machines. But in addition to this, it is necessary to have a clear idea of company planning. To link a good piece of tool machine equipment to a good computer and to have everything function properly is not easy. This is where the new relationship has come about, involving the traditional planner, the engineer, who knows how to build a car, and the computer expert. But besides this, we are afforded an extra benefit; namely that of simulating, through use of the computer, the application of a new system in order to immediately spot the limitations and the choke points that can occur during actual operations."

What is the near term outlook for automation as applied to industry? "The new horizons belong certainly to sensoral machines, namely those able to see what they touch and what they do, those eventually able to react in a timely manner to unforeseen events."

Furthermore, Comau can be viewed as a privileged observation point from which to understand how the introduction of systems based on automation in the manufacturing field is proceeding. "There are still difficulties and resistance to change," continued Cigna, "in accepting what is truly a cultural transformation, but it is certain that Italy is one of the countries where companies, especially the larger ones, have for some time taken note of the importance of this new technology. It may appear strange, but I have noticed a greater receptivity to this kind of innovation in manufacturers of our country, where our market presence is more consolidated, than with those of America."

What are the most important developments of these new systems and in which direction will they be heading? "Though some time had to pass, now all have accepted the idea of a computer in the office. This is true not only because it makes sense from an economic planning view point, but it also provides for better labor coordination. In reality, the office computer is a keystone for a new philosophy in production. For the time being, the introduction of software is still sporadic and done in piecemeal fashion. Administrative or warehouse bookkeeping is now perhaps done totally by computer, whereas only a part of production machinery utilizes computers. Today this type of situation is found often even in medium to small size firms. Now, try to imagine a manufacturing plant where computers talk to one another: those that guide production transmit data to those that control warehouse supply and these in turn are linked to terminals in the administrative bookkeeping section. Production, warehouse, and sales data, to include those of retail outlets, could constitute a whole, in and of itself, capable of programing a company's life in a totally new manner. This, to me, seems to be the most important aspect of automation. Of this prospect, industrial robots are definitely an essential part, but still only a part. The final say is still up to man and his capacity to organize and control the entire process."

Robot Type	Italian Market			Balance	Import/Export(*)	
	Pieces Sold	Value in Millions	Employment (by year)		Value in Millions	Employment (by year)
A	1.000	5.000	182	+ 2.000	+ 10.000	+ 363
A°	80	3.200	30	0	0	0
B	80	8.000	116	-40	-4.000	-58
C	100	10.000	145	-50	-5.000	-72
		26.200	473		+ 1.000	+ 223

(*) A minus sign means quantities imported, a plus sign indicates exported quantities.

(A) Nonprogrammable automatic arms; (A°) Programmable automatic arms; (B) Single function robots; (C) Assembly robots.

Contribution by Small Companies

Milan SUCCESSO in Italian Jul-Aug 81 p 39

[Article: "Small Italian Robots"]

[Text] If Italy builds and exports industrial robots, the credit will not go only to the "greats" such as Olivetti or Comau. The success scored by Italian industry in this sector is due in large part to a whole string of small and very small companies. It is these companies that took the plunge, with few means but with many ideas, into the international market of robotics. Which robots are we talking about? Those which are commonly known as first and second generation units: machines used to move material while it is being worked on (pieces for a press or for an assembly phase), robots for painting or automatic machine tools.

Let us take for example the Jobs company of Piacenza, a company that employs about 40 people that produces conveyance robots and machine tools for special tasks. Giacomo Pagani, the company's founder explained: "One-third of what we produce is exported abroad. Our robots can be employed in various functions and are also available to small companies desiring to improve their organization."

The Basfer company of Monza can also attest to the robot's versatility. The company employs 100 people and has become specialized in painting for at least the past 4 years, about the time frame when the auto and household appliance industry began to substitute personnel with robots in what perhaps are among the most harmful work operations. Fifty percent of Basfer's production is sold abroad. (In the United States they formed a holding company with Nordson, which makes use of their patents.) Their machinery can be used in the auto sector (FIAT, Alfa Romeo and Mercedes-Benz use them), as well as by the manufactures of sanitary equipment and of metal furniture. In the field of painting, there is another company that is typical of "the Italian way of robotics." It is called SLS, in the province of Varese. About 10 technicians with an artisan background have perfected a completely automated painting micro-system that permits sand blasting, spraying and metallization. Robox of Castelletto Ticino in the province of Novara also has only a few employees: 23 in all. They include engineers and experts that have applied their experience in software to various tool machines. Today they export 70 percent of their production, mainly to the United States.

The Camel company of Palazzolo (Milan), which employs slightly more than 20 people, manufactures two types of robots: a general purpose unit (for handling and follow-up linking) and a "dedicated" robot, used only for specific tasks, such as at the presses or at the foundry. Together with other small and medium size Italian companies (such as Jobs and Gaiotto), Camel is represented on the British market by Ferrey, which is responsible for the distribution of Italian robots in a country that from an automation point of view, is less advanced than ours.

How can one explain the success of Italian robotics? It is due first of all to two factors: a great tradition in mechanics which has always made our country an exporter of means of production items. (Let us not forget that in the field

of tool machinery, Italy is fifth in world production and the third in export volume.) Second, a marked capacity to adapt to electronic innovations as well as to change in the field of applied research. None of the small enterprises we mentioned has a research department in the true sense of the word, but they all have a bit of the researcher and innovator qualities in them.

Taking the pulse of these companies can give one an indication of how Italian industry is reacting to the advent of automation. Mr Campa of the Norda company in Brescia stated: "We sell to FIAT and to Volkswagen as well as to small- and medium-sized companies that manufacture anything from pans to scissors. We have learned that a company, small though it may be, acquires robots for three reasons: to obtain greater security on the job (by improving the working environment); to be able to plan a specific rate of production; and being able to remove workers from professionally less rewarding tasks and direct them to more satisfying work." Norda, a company that began 10 years ago and has 60 employees, started with conveyance robots and recently introduced a new model, the "Modulo," a versatile machine that takes up little room. (Space has always been a major problem for robot planners.)

Mr Pagani of the Jobs company wishes to dispel the long held notion that only large companies can permit themselves to have robots and to have the courage to introduce them into the office. "At times, fear of making a mistake can affect the bureaucratized staff of a large company more than a small one, while the small company has the courage to run risks. In reality, many large companies do a great deal of research, but when the time comes to apply theory, they hesitate."

Mr Davini of Basfer has a less orthodox point of view: "Large companies now pay great attention to these kinds of innovations. They know that, in the long run, missing certain milestones can cost them dearly. But it is also interesting to see how robots are used by small though efficient companies; we have sold our units to four or five very small companies, which however had enormous production outputs. They have now solved their problems."

The case mentioned by Davini occurs with much more frequency than commonly held in this country, where small and medium industry play such a relevant role. At this point new problems arise because as Mr Castoldi of Camel stated: "Large companies can guarantee maintenance by making use of specialized technicians and can count on a precise planning program." It is for this reason that companies which manufacture robots will find it necessary to improve their service contracts if they want to expand among small and medium size companies. On the other hand, the latter will have to improve the professional quality of their personnel.

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CSO: 3102/380

INDUSTRIAL TECHNOLOGY

AUTOMATED DRILLING MACHINE TO HELP IN AIRBUS PRODUCTION

Paris INDUSTRIES & TECHNIQUES in French 1 Jul 81 p 28

[Article by A. L.: "Ultra-Precise Automatic Drilling"]

[Text] Ten minutes of machining instead of two days of work. And yet this machine was selected primarily for its precision.

Aircraft construction must automate its drilling operations. The Societe Europeene de Propulsion, in Bordeaux, has just received a special nine-tool machine for fabricating a removable insert: a 1800 mm-diameter crown of composite material, installed in the Airbus jet engines. Up to now, the drilling of internal and external holes, as well as the milling of a slot by hydraulic tracing, were executed by two operators equipped with portable tools. They needed one day to finish one part, with no guarantee of 1/500-th precision and of H7 diameter accuracy for the holes: hence a very long final quality control.

Does this low productivity alone justify the investment in an automatic machine with a single operator? Certainly not, since the plant barely makes ten of these parts per month. But aircraft builders are very sensitive about product quality and reliability of supply; automation assures not only perfect quality, but regular production as well. Moreover, a machining time reduced to 10 minutes eliminates the need for buffer stocks; the manufacturer can fill an unexpected request within one day. The latter advantage becomes primordial if the Airbus fabrication rate increases from four to eight per month, as anticipated. And finally, the general trend toward industrialization in aircraft construction, particularly among nationalized groups, is not satisfied with a large amount of hand-drilling which creates large intermediate stocks and demanding quality controls.

The originality of the Sep machine rests in the tool-bearing arm for drilling the internal face of the crown; it is articulated and moved in the vertical plane by a jack; when not in operation, it rests in its upper position and frees the table which supports the crown. When the latter is in place and clamped down, the arm descends to a horizontal position and is then splined and locked at the center of the table. A step-motor turns the table to 24 successive positions, at each of which the tools held by the arm machine the section of the part which faces them.



Drilling a composite ring.

The fixed external drill and the tracing mill operate at the same time. The articulated arm is one of the major justifications for using an exclusively pneumatic control. Pneumatic tools weigh less and occupy less space; in this case, the single-spindle 0.85 hp head, turning at 5000 rpm, weighs 8 kg and passes through a 64 mm opening.

This machine is the flagship of the Georges Renault pneumatic tool special machine department, at Rueil-Malmaison. For the last three years, this team of some 15 young technicians has been involved with special single- and multi-spindle, small diameter (2/10-th to 15 mm), special drilling and tapping machines. As intense as it is casual, the team is gaining a solid reputation for professionalism. Because most of the pneumatic programs that are being used in the small enterprise have a family resemblance, the team has devised a profitable gadget in the form of a pre-wired pneumatic circuit (block) for a standard drilling cycle. Fabricated in small lots by Chantiers de la Ciotat, it is less expensive than it would be if it were manufactured one at a time, even when one includes the cost for adapting to each special case.

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CSO: 3102/389

INDUSTRIAL TECHNOLOGY

NEW THIN-LAYER DEPOSITION PROCESS DEVELOPED

Paris INDUSTRIES & TECHNIQUES in French 1 Jul 81 p 74-75

[Article by Genevieve Coat: "Transparent and Conductive Deposits on Glass or Ceramic"]

[Text] A transparent and conductive metallic oxide coating is deposited by pyrolysis of an ultrasonically-produced aerosol. The layer of several hundreds to several thousands of angstroms is homogeneous.

Traditional coating methods are poorly suited to current needs. Vacuum depositions require expensive equipment and very thermally-stable materials, while air spraying does not produce homogeneous layers.

The process recently perfected by Cea (Laboratory for the Study of Thin Materials) is free from these inconveniences. In particular, it assures good homogeneity on plane surfaces, at thicknesses ranging from several hundred angstroms to about one micron.

Among the materials deposited by this process are some metallic oxides with special electrical properties (resistivity lower than 10^{-3} ohms/cm, for instance), whose use as resistive heating elements imposes itself wherever mist or frost has to be eliminated. However, one of the most interesting applications of this technique is the deposition of indium oxide. From a purely optical standpoint, the thin layer that is formed is transparent in the visible and reflecting in the infra-red. In addition, and depending on operational conditions, this material makes it possible to obtain a whole range of resistances per square (beginning with 7 ohms) which carry an electric power of several watts per square centimeter (up to 30 under particular conditions). Moreover, indium oxide has significant resistance to most chemical agents and proves to be very stable in air and in vacuum! At 180 degrees C in air, no changes occur in the optical and mechanical properties of the coating after 150 hours; under vacuum (10^{-2} mm of mercury) and at 500 degrees, this duration increases to about 200 hours. At 450 degrees in nitrogen, the electrical resistance increases by 35 percent after 20 hours, and remains constant subsequently. Mechanically, the coatings are very hard and in some cases improve the abrasion resistance of glass. Adhesion is perfect, whether the substrate is glass, quartz, or even ceramic.

This combination of optical and mechanical properties makes this very reliable technique appropriate for very many fields: insulation of building windows, oven windows, driers, solar collectors. But the coating is also suitable for conductive glasses (transparent electrodes), anti-static glasses (electron tubes), and heating glasses (windshield de-icers in planes, contacts, heating tubes, anti-fog coatings for photoelectric cell lenses, transparent ovens for laboratories).

The originality of the process lies in its principle: pyrolysis of an aerosol obtained by ultrasonics. During trials, the deposits were first obtained with laboratory equipment appropriate for small plane surfaces (63 X 63 mm). A moving-belt machine prototype has made it possible to extrapolate to larger dimensions (400 X 300 mm) and to conduct tests, particularly on non-plane photoelectric cell lenses.

The transition to the coating of thousands of lenses with indium oxide has helped to finally perfect the specifications of this type of treatment (1000 ohm resistance with a precision of +/-10 percent). Since then, several modifications have led to industrial development, reducing the number of lenses that are out of specification, accelerating production rates, and improving the deposition yield.

As of now, potential market studies leave no doubt about the future of this technique, especially since it appears to be applicable to the fabrication of thin films of tin, iron, chromium, yttrium, and titanium oxides. An industrial machine presently under construction will be operational in September 1981. It will consist of a tunnel furnace, six meters long, which will have at its center the device which supplies the ultrasonically-produced aerosol. It will make it possible to treat plane or curved glass substrates whose dimensions will reach 200 mm in width and 500 mm in length.

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INDUSTRIAL TECHNOLOGY

BRIEFS

RENAULT'S SEEING ROBOT--The first shape-recognition robot will be installed in July at the Cleon (Seine-Maritime) plant. Thanks to its camera eye and to combinatorial calculus, it will be able to identify and grasp one of many crankshaft randomly piled on a pallet, and place it in a transfer machine; this apparently simple gesture nevertheless requires no less than 1000 billion operations. "We have 4632 intelligent handlers in our group as a whole," explains Mr Jean Lagasse, director of scientific and technical affairs, "and if the Japanese claim to have 46,000 it is because they count all the simple automatic devices which have been in use here since the 1950', and which are not real robots at all, when the latter are defined as 'articulated and programmed mechanical systems which are capable of adapting themselves to their environment.'" The programming of a flexible shop--the most sophisticated form of robot--requires three to six months, and through simple program modifications allows the integration during operation, of technologic innovations or new market demands. [Text] [Paris AFP SCIENCES in French 25 Jun 81 p 17] 11,023

CSO: 3102/389

TRANSPORTATION

'AXIAL' ENGINE RATES HIGH IN EFFICIENCY, PERFORMANCE

Paris L'ARGUS DE L'AUTOMOBILE in French 16 Jul 81, p 8

[Unsigned article: "The Brille Engine: Revolutionary and Economical"]

[Excerpts] Automotive reporters are regularly importuned by strangers who claim to have simply reinvented the automobile, or improved the Carnot cycle! Unlike them, Mr Brille, inventor of an axial engine, has never importuned anybody, and receives only esteem and respect from his colleagues in the Automobile Engineers' Society, his 30 years of research at Citroen and Renault speaking eloquently on his behalf.

Since his retirement nine years ago, he has been using his own resources to perfect an axial engine. He would gladly call it a tumbler engine if the term had not become somewhat devaluated over the years, many inventors having proposed engines of this type, whose mechanical efficiency turned out to be so poor that they have discredited this tumbler configuration, which resembles that of a revolver's tumbler, where the rotation shaft is parallel to the axis of the engine's cylinders.

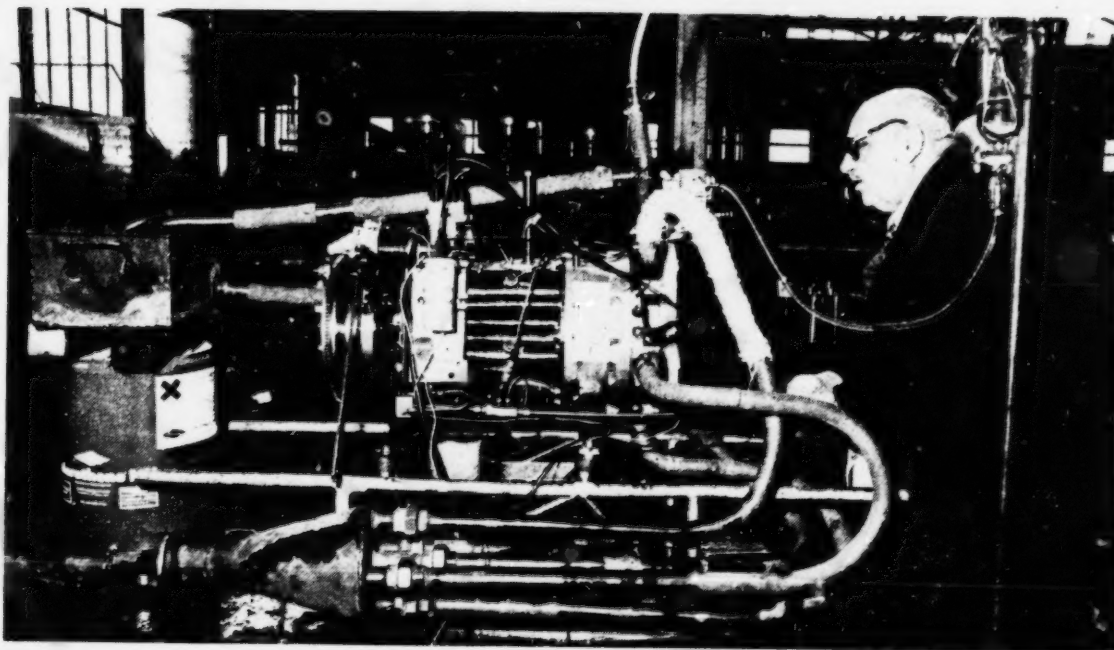
The axial concept for a thermal engine is so obvious that the first person to have used it was James Watt. We can thus clearly see that while the idea is an apparently simple one, its construction is much less so. The Brille engine combines several fundamental advantages:

The tumbler concept, is synonymous with compactness and light weight, provided it is well carried out;

Excellent mechanical performance: the Brille engine with 5, 7, or 9 cylinders, will in all cases have only two main bearings and a single rod bearing consisting of ball-bearings, thanks to a crank system based on the geometry of cones, and to a central pivot with conical gears (ring-shaped);

Minimum friction coming only from the piston movement in the cylinders, and further reduced by the approximately conical movement of the pistons, and the near absence of lateral thrust, resulting from the minimal inclination of the piston rods, amounting to 2 degrees at most;

A major innovation in piston engines, the Brille concept makes it possible to easily vary the compression ratio automatically or manually, by axially displacing the crank-rod-piston assembly by 10 to 20 percent of its travel without additional friction.



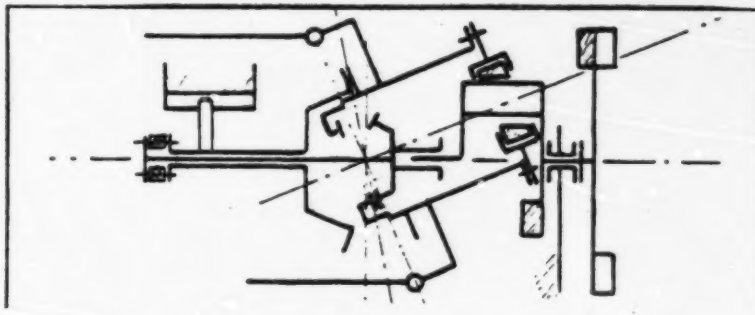
Maurice Brille with the motorized model. On the right, the original head milled out of aluminum. The central portion (black) is the machined and welded engine block. On the left, the ignition, starter, and flywheel. It can be seen that this model can be readily shortened into a final engine.

Successful Synthesis

In addition to the structural advantages of the Brille engine, the variation of the compression ratio effectively bridges the most recent innovations in thermal design (combustion chambers), and the old dream of all engine designers: not only to make engines accept a number of fuels, but take advantage of the variable compression ratio to optimize engine efficiency regardless of circumstances. The most obvious example is the cold start (a really cold one, rather than at 20 degrees centigrade as in official specifications!), where an increased compression ratio provides an efficient solution to (rapid) engine warmup. In short, the Brille engine is actually the only one which makes it possible to maintain the combustion mixture at optimum temperature before expansion, and consequently to maintain thermal yield at maximum efficiency in every case, and notably at partial load: like it or not, one of the main advantages of diesel engines vanishes with Maurice Brille's variable compression, axial gasoline engine.

As Far As It Will Go

The design of tumbler engines has always failed between the piston rod and the power takeoff shaft. To enumerate all the systems conceived so far would amount to an encyclopedia of solutions which use cylindrical cams, fingers or rollers set at an angle to the shaft, cams (including Mitchells), and Z-cranks with oscillating disks;



Latest version of the Brille engine. The crankshaft drive system and the dish construction have been significantly changed: the engine has become more reliable, and easier to install and manufacture.

engine which has not yet been built for lack of means, is therefore perfectly optimized in terms of calculations, and since many engineers have participated directly in its design, a virtual team is now available to Mr Brille, ready to undertake the development of the project.

Quite naturally, many companies are interested in the project, especially in Germany, but they are all waiting for figures to prove the soundness of the theory. This has now been done, and the comparative drive diagrams obtained at the National Test Laboratory with an engine model that Mr Brille deems unworthy because it is so far removed from a true model, show that the inventor was right. Compared to an excellent two-liter engine as reference, this fragile mock-up is already superior (see curves). However, Mr Brille did not wait for these tests to design an engine that is really suitable for mass production: patented by now, it revives the principle of radial engines (very simple and inexpensive), and has reduced the initial angle of the dish to 18 degrees (computer optimization) from the original 22 degrees and 30 minutes dictated by obvious requirements for design simplicity. This 7-cylinder engine, shorter than a conventional 4-cylinder one, offers a large number of advantages while retaining a similar price range, which is essential and already calculated.

To Be Continued

Public support, effective so far because it financed a collaboration with the university, will be continued only if an industrial enterprise will undertake to support Mr Brille, who cannot continue to perfect the engine out of his own resources. Let us hope that this happens soon: it would be so desirable for this solution to remain a French one.

(1) Couples d'entraînement comparés

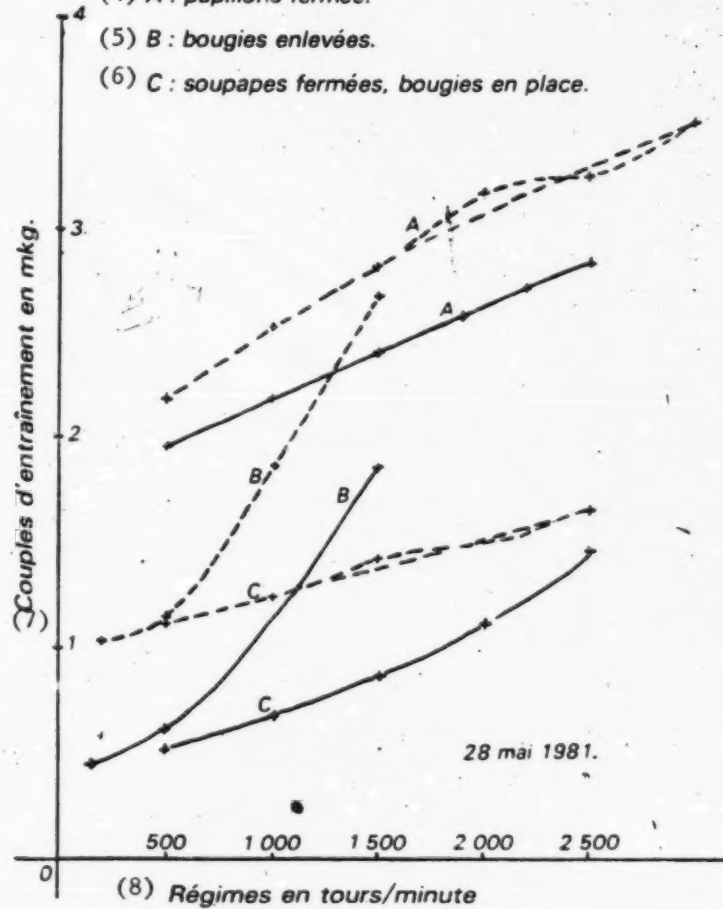
(2) - - - - - moteur 2 litres classique

(3) ————— moteur axial 1,960 litres (Br.)

(4) A : papillons fermés.

(5) B : bougies enlevées.

(6) C : soupapes fermées, bougies en place.



Each engine, the 2-liter, 4-cylinder in-line reference engine, and the Brille tumbler engine, are driven by a motor. Three series of measurements, butterflies closed, spark plugs removed, valves closed-spark plugs in place, were performed. The third test is the most significant by far (curve C) and gives an undeniable advantage to the Brille engine. Large oil suction in this--very tired--engine has prevented its reaching full power.

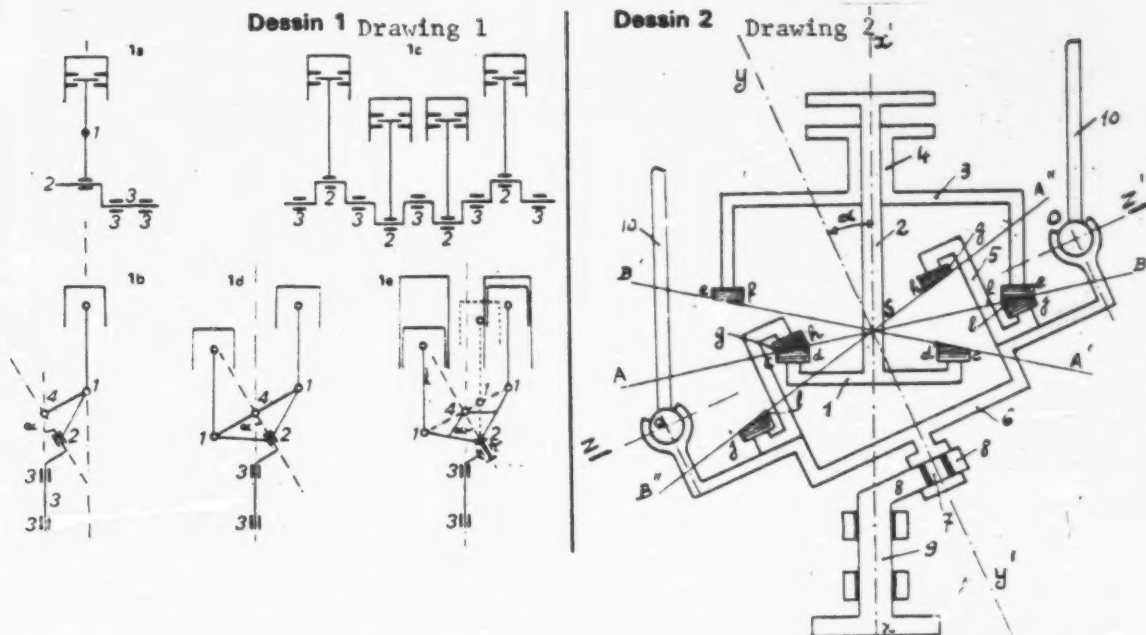
- Key: (1) Comparative drive torques
(2) Conventional 2-liter engine
(3) 1.960-liter (Br.) axial engine
(4) Butterflies closed
(5) Spark plugs removed
(6) Valves closed, spark plugs in place
(7) Drive torque in mkg
(8) Revolutions per minute

Already valuable for cars, the tumbler engine is equally as useful for a number of gasoline or diesel, civilian or military land applications, and even more so for aeronautics: the axial layout of the cylinders and the power increase obtained from the variable compression ratio, are perfect for aviation (notably takeoff and landing). We have watched the poor, tired model operate with "mayonnaise" (water mixed in oil) without stopping; this provides additional reliability for users.

Turbocompressors, far from being incompatible with the tumbler structure, are beautifully adapted to it. So much so that it was one of Mr Brille's initial ideas, since the arrangement of the cylinders encourages the central location of a turbine: it takes advantage not only of the kinetic energy of exhaust gases, but also of their blast effect. In point of fact, the present engine has a circular intake manifold where it was noted that the burned gases turned in a direction opposite to that of the engine. Clearly, much remains to be discovered and great benefits can therefore be derived from an engine which already outclasses in-line engines thanks to variable compression, eliminates the choke, and consumes 50 percent less fuel in congested traffic.

Tentative Conclusion

While basically attractive, the tumbler configuration had fallen in disrepute because no one had been able to come up with a reliable and efficient crank design. The great virtue of Mr Brille's concept is that it offers a simple and efficient system which opens enormous opportunities to those who produce or use internal combustion engines. It so happens that the invention is a French one, and it is up to us to take advantage of it.



The Brille engine: a complex theory, a very simple system.

To explain the principle of motion conversion, we called on a specialist, Mr Brille himself, by reprinting extracts from the paper he read at the FISITA Congress in May 1974.

Drawing 1

Sketch 1a shows a single-cylinder engine. In order to bring the axis of the engine parallel to the axis of the cylinder, the piston rod is broken at point 1 (sketch 1b); its lower portion remains connected to crank 2, which is bent at an angle of 20-25 degrees to the engine shaft 3; the engine shaft is now parallel to the axis of the cylinder. The thrust of articulation 1 is received by a triangulation bar attached at 1 and 4, the latter point being located on the extension of shaft 3 at the intersection with the extension of crank 2. With the rigid triangle 1-2-4 turning around point 4, and as long as point 1 is maintained essentially in the figure plane, engine 1b operates like engine 1a.

In 1b, the axial displacement of the assembly can occur by maintaining the cylinder and the bearings of shaft 3 fixed as part of the block; this makes it possible to vary the upper position of the top of the piston with respect to the head of the cylinder, and thus to vary the compression ratio. But the cost of this advantage is rather high in terms of significant complexity and of additional friction at pivots 1 and 4.

The picture changes when we move to multi-cylinder engines, and the advantages of the axial type become more evident as the number of cylinders increases. Sketches lc and ld show the transition to four cylinders. At this point, lc has nine bearing surfaces while ld still has only three, which actually work scarcely harder than each of the earlier ones. Moreover, they can be ball bearings, a favorable factor which is not really feasible for the crankshaft of lc. In space, the triangle 1-2-4 now becomes the solid 1-4-1-2, or pivoting dish, where line 1-1 is a circumference on which the four piston rods articulate. In this case there are eight pivots, plus the central one. Since friction losses are especially large in bearings, particularly at high speeds, the advantage of ld over lc then becomes evident as long as the pivots are handled so as to maintain very low friction.

Configuration of Dish

While maintaining its rigidity, the dish can be configured (sketch le) to allow larger clearances, with a freer articulation 1 and a pin at 2. To avoid misalignment constraints, pin 2 must be axially restrained in both directions in its bearing, which in turn is mounted as a ball-socket on the crank; after installation, this ball-socket has no further relative motion with respect to the crank.

Drawing 2

Simplified sketch of the kinetic verification model. The angle α is equal to 22.5 degrees. The dish (6) is maintained in place by the teeth of crowns 1 and 3, which are clearly mobile and can be moved vertically, with the result that the rods (10) and their pistons can be raised to increase the compression ratio.

11,023

CSO: 3102/379

TRANSPORTATION

DORNIER'S DO 228 COMMUTER PROGRAM REVIEWED

Stuttgart FLUG REVUE in German Aug 81 pp 49-52

[Article by Helmut Penner]

[Excerpts] With DM 15 million in support from the Ministry for Research and Technology, the Dornier company began an experimental program which, after 6 years, has for the moment reached a successful conclusion with the maiden flight of the Do 228-100 and Do 228-200 prototypes. If the South German company had been active until now only in the utility sector with the Do 27, Do 28 A and B and the Do 28D Skyservant models, it now wants to push ahead into the commuter market with the 228 series. So far there have been 31 firm orders and 83 options for the Do 128/228 family.

Starting with the fuselage-tailplane configuration, the 228-100 is given intermediate fuselage sections--each 762 mm long--which are inserted in front of and behind the wing area and which lengthen the fuselage, the nose of which was newly developed for the twin nose wheel, by 3.34 ms and 4.68 ms respectively.

There were problems in the redesign of the nose landing gear for low-pressure tires. At first the TNT New Technology Wing used production landing gear from the Alpha Jet, slightly modified for the production aircraft. The narrow track made a stop-gap solution necessary, which used slight negative camber to gain a few extra millimeters. In contrast to the old versions, the designers found that they had to design the landing gear to be retractable, which naturally led to additional solutions to these problems. The newly designed main landing gear can be housed in pods built into the side of the fuselage structure.

The tailplane unit is taken over unchanged from the 128 series.

It appears to be a negative factor that with the new fuselage design the cabin cannot be pressurized, as the service ceiling is quoted as only 9,020 ms, and service ceilings which may be up to 15 percent lower than those of competing designs can be attained. Dornier would like to avoid this problem with a later 30-seat version, designated LTA. Since the airplane will be used principally on short routes, in spite of its tremendous range of 1,150 to 1,970 kms, not quite so much importance attaches to the attainable ceiling.

The power output of the 2 Garrett AiResearch TPE 331-5 engines, of 715 SHP [Shaft Horsepower] each, gives the aircraft a takeoff run of 526 ms and a climb rate of 10.4 ms/sec, due also to the additional lift devices. Pratt & Whitney PT6A-135 turbines of 750 SHP and PT6A-41 turbines of 850 SHP are planned for use in later versions.

The wing, which is basically identical to the TNT wing, is the same in the 228-100 and the 228-200. Experts believe that the NC New Construction machining process developed for the first time for the wing section, and which is being applied in a simplified form in components of the Alpha Jet, will result in a great cost reduction. The sections, consisting of an upper and lower surface and machined from a single piece of aluminum, are shaped to their predetermined profile in presses and riveted only at the leading and trailing edges. This is a manufacturing process which has never previously been applied in aircraft construction in this way, which can bring enormous savings in work hours and which can point the way to the future in aircraft construction. Some of the wing leading edges and wing tips have structures of carbon fiber.

The overall design of this plane, costing DM 2.7 to 3.0 million, which falls into the 5.7-ton weight class, is intended to increase usable weight capacity, and this was achieved primarily with the new wing. Compared with conventional designs, this means an increase of 25 to 40 percent and a fuel savings of up to 30 percent. In addition, the design provides for an increase in cruising speed and a phenomenal rate of climb in spite of the increased takeoff weight.

On the basis of its good performance the ability to operate from high-altitude airfields is especially pleasing. With a cruising speed of 400 kms/hour the number of operations can also be increased compared with other designs. If Dornier had previously directed itself only to the utility application of aircraft, for the first time it had to adhere to the standard of the commuter users. The conformation of the cabin, which the rectangular fuselage cross-section does much to help, was the subject of especially long deliberation. Convenience and comfort for the passenger are of primary importance. The seats are separated by a central aisle. The double passenger loading door in the rear fuselage section, with its built-in stairway, allows easy entry and loading. Additional baggage capacity is available in the nose to supplement the rear baggage space.

First Production Aircraft at the End of 1981

The first production machine will be delivered at the end of this year following model certification. Monthly production is planned at five units. Preparations have been made at the Dornier works to aim at an initial total production of 300 aircraft.

The airplane, which has been designed for a total life of 24,000 hours--this is the equivalent of an operational life of 15 years without repairs to the primary structure--was developed to comply with FAR [Federal Air Regulations] Part 23 and SV [Safety Regulations] 41. The class of buyers concerned, primarily relief airline companies, will in future have to examine closely what they are getting for their money. One thing is clear: There is as yet no direct competition for this quiet, extremely economical, modern-style short-takeoff aircraft.

First Results of the Test Flight

Following the first test flights, Dornier test pilot Dieter Thomas stated that all the expectations that had been held concerning the aircraft had been fulfilled. Some of the calculated levels of performance had already been reached in flight. Flight characteristics were satisfactory, and the systems would still have to be tested individually. The first impression was extremely positive. It was thought that certification of both versions could be granted after 100 to 120 flying hours, which would mean a considerable reduction in time compared with traditional certification procedures. Thomas named two deadlines: 17 October 1981 for the 228-100 and 23 December 1981 for the 228-200.

Dieter Thomas gave an interesting pointer: The Hoffmann Propeller Construction company in Rosenheim is working with the Dornier company on a special propeller under an experimental program. Initial results indicate an entire new generation of propellers. The OLGA turbulence reduction system will likewise improve passenger comfort. As a result of the partially lower operating heights when flying at lower levels, the aircraft is occasionally subject to stronger turbulence than aircraft flying at greater heights. The OLGA system promises to make aircraft operating in commuter service more comfortable for the passengers.

9581

CSO: 3102/381

TRANSPORTATION

DORNIER EXHIBITS EFFICIENT, ECONOMICAL 228 COMMUTER

Gelsenkirchen AEROKURIER in German Jun 81 pp 704-706, 708, 710, 712

[Article by J. Doerpinghaus: "Do 228-100/200: The First Time With a New Technology Wing. Dornier is Betting on the Commuter Market"]

[Text] They carry the show numbers 001 and 002 at the Paris Air Salon, the two new "Utility" and "Commuter" models from Dornier, the Do 228-100 and the Do 228-200. Thus the FRG is represented at the Paris Air Salon by two genuinely new exhibits, so new that both aircraft together had probably completed scarcely 50 flying hours on their arrival in Paris, including the transit flight from Oberpfaffenhausen to Paris. Both models, which reveals hardly any signs of their historical kinship with the Skyservant, have been designed for one of the fastest growing markets in air travel, the commuter market and the so-called third-level feeder and short-haul aircraft market. According to U.S. prognoses, this market will increase by 10 percent annually, while other markets in air travel are tending, if anything, toward clearly smaller growth rates. The principal technological feature and also the principal sales argument for the new 228-family is the new-technology wing, "TNT" for short. In fact this abbreviation conceals some brilliant ideas, a new, extremely low-drag profile, a wing plan very close to the ideal aerodynamic shape and a wing structure that is new both in construction and manufacturing technology.

The new wing also holds the secret of the extraordinary performance which the Dornier can achieve, in spite of engines that are, if anything, of only average power for its size.

While the smaller Do 228-100 has space for a total of 15 passengers, the 228-200 can carry a total of 19 passengers. For reasons affecting registration and customers' operating licenses, both aircraft have a maximum takeoff weight of 5,700 kg.

However, the design offers sufficient technical reserves to increase the maximum takeoff weight substantially at a later date.

It was the performance, or more precisely, the performance, purchase price and the expected economy of operation together which attracted attention worldwide after the announcement of the 228. This is true both of potential customers and also of other manufacturers, who are so impressed by the expected performance of the TNT that Dornier is said not to be short of offers to cooperate. After mature reflection the company decided to see the Do 228 through alone, under its own direction. The correctness of this decision has been confirmed by two successes: the incredibly short time in which the two aircraft went from the drawing board into the air, and the confirmed sales and options that were received even before their maiden flights, which seem to give the old-established company every reason to hope for a solid market success. According to unofficial statements, Dornier likes to be extremely reticent in this respect, more than 20 aircraft have already been definitely sold. There are already options on another 35 machines, and all of this before the aircraft flew for the first time, before it was really known internationally. Preparations are already under way at Dornier for a 1st production run of about 50 aircraft. The preparations for production as well as construction of the prototypes are being pushed ahead vigorously, because the company wants to preserve the time advantage it already has.

The commuters are coming: a class of airplanes which a few years ago would have been assigned an outsider's role at most is wakening to new life: the feeder airliners and small commercial aircraft for second-and third-level air travel.

The demand for airplanes in this category has jumped worldwide. Manufacturers of suitable designs have been unable for some time to keep up with deliveries at the same speed as market demands for aircraft in this category. The reason: traditional airline transportation is in a deep-seated international upheaval. Because of the recent explosive rise in fuel prices, the airlines can use their large machines only on those routes that guarantee high seat occupancy for the entire flight. Even more, smaller and older airplane designs are being withdrawn from service prematurely in a program of so-called route and frequency cleanup and are being replaced by larger and/or more modern equipment with which passenger-miles can be achieved at favorable rates. The consequence: more and more air connections are being cut and flown less frequently because the number of passengers is not sufficient to fly a DC-9 or a Boeing 737 and cover costs. Added to this are the high takeoff and landing fees, airport handling and flight insurance services that the airlines have to pay for the operation of their large aircraft and which are driving the breakeven factor even higher, that is, the point after which the demand on a route is sufficient to fly with a particular design and cover costs.

If, in earlier years, the big airline companies could afford to operate at a loss on certain routes in the interest of the traveling public, such possibilities are almost nonexistent today, since most of the airline companies are operating in the red, not a few are hardly able to meet their payment obligations to the aircraft manufacturers and some are no longer even financially in a position to accept the airplanes ordered from the manufacturers and now ready for delivery. Against this backdrop, the airlines have no option but to cut the routes which they cannot fly and cover costs with their equipment. The consequence for the flying public is that fewer and fewer cities can be reached less frequently by airliner. This development is already most pronounced in the United States, which, in conjunction with the prior deregulation policy of President Carter, has undergone a major upheaval in its air traffic structure in the last few years. This development can now be observed in Europe in a somewhat different context and under different conditions.

The economy, however, needs the airplane, the rapid air link, more than ever today, independently of whether enough "filler-passengers" fly to fill a full-size airliner. In all the places where the large airliners are forced to withdraw because of insufficient capacity, smaller companies on the feeder and short-haul level--now called "commuter" for short in modern German--are struggling to gain an entry in the gap left by the large carriers.

The secret of their success: they are operating with equipment in the range up to 20 seats, a number that can easily be filled. Higher demand is usually compensated for by a higher frequency of flights. There is great flexibility here. The only problem for these commuter airlines lies in the airplanes, or more accurately, the aircraft which cannot be bought at the moment, or not in sufficient numbers, and which are based anyway on the technology of the 1960s and 1970s, at least as far as the airframe and aerodynamics are concerned.

American studies talk in terms of an average growth of the commuter airlines for the next 10 years of more than 10 percent annually. Such growth rates have become rare in presentday air traffic.

In Europe too, there is a strong demand for airplanes in this category, not only to be able to continue operating unprofitable routes, but also to be able to start flights on routes between so-called medium-size centers--particularly across international frontiers--to the extent that political arrangements can eventually be reached about this.

Dornier is taking precise aim at the feeder and short-haul route services with the new 228-family, which is being presented publicly for the first time at the Paris Air Salon. The remarkable thing about the new Dornier commuter program: after the German aviation industry spent far too much time pursuing the idea of the "market gap," which it thought it had to find in order to ensure success, Dornier is planning to enter a hotly contested market, a market which is not a hypothetical market between other markets, but which has been discovered in the meantime and attacked by many manufacturers, thanks to its demand potential.

Dornier is putting itself squarely up against international competition.

In order to successfully meet the competition, which is well established in part, Dornier has come up with some technological ideas that were nonexistent in this category of aircraft previously. Particular mention should be made of the spectacularly low-drag and energy-saving:

- new technology wing and, integrated into the design,
- manufacturing knowhow, which had been previously applied only to high-performance aircraft. Last, but not least, through long-term, goal-oriented and well thought out preparation of the project on the research side, Dornier can offer not only a substantial lead over the competition, but also,
- extraordinarily favorable prices, which should be particularly attractive to the smaller companies which are in many cases weak in capital.

It is no surprise that interest in the new Do 228-family has awakened worldwide, and that Dornier--just a few weeks after the maiden flight of both prototypes--can cushion itself on a volume orders that is unusually high by European aircraft construction standards.

The first two production machines will stay in Europe, which is not a matter of course, given Dornier's traditional good relationships with Third World markets. Production Number 1 is going to a Scandinavian customer, while the second aircraft is destined for a company based in Switzerland.

As the group designation Utility/Commuter for the 228-100 and 228-200 shows, the new Dornier family is designed for a broad spectrum of use. Naturally, passenger traffic on short-haul feeder routes is of primary concern, as well as links between so-called subcenters, which would otherwise be left without any air traffic connection. Both models are also suited for all kinds of freight transportation, for dropping parachutists and for SAR (Sea-Air Rescue) service. Because of its excellent fuel consumption, the 228 is also suitable as a flying laboratory and for patrol duties at sea, for example, for coastal and fishery protection.

Initially, both models are being equipped with Garrett AiResearch TPE 331-5 [as published] engines, each producing 534 kW (715 SHP Shaft Horsepower). Dornier is considering offering both models at a later point in time with PT6 turbine engines, given sufficient customer interest.

A Realistic Philosophy

There was once a time when pretty much each year one manufacturer or other presented a design, which, it claimed, was the ideal successor to the DC-3. As is known today, no one design--with the possible exception of the F-27-- has successfully followed in the steps of the DC-3. Until this day the DC-3 has remained its "own successor."

Something can be learned from this story, and perhaps Dornier had some of this knowledge in mind when the 228 was designed.

First there is the fact that the customers for airplanes in this category are mostly smaller companies, which simply do not have the capital to use expensive equipment, but are glad if they can just pay for machinery at the best price.

Practically all the successors to the DC-3 failed because they were much too expensive in comparison to the model they were supposed to replace.

So it was clear to Dornier that the 228-family had to be designed as cost-effectively as possible so that it could actually find a place in the market.

Low operating costs are in fact even more important than an initially low purchase price.

With the new-technology wing, Dornier is competitive in this area as well. The Do 228 will use considerably less fuel than a comparable aircraft of the same size with a conventional wing design. The saving in fuel alone is quoted at about 30 percent, which, with today's kerosene prices, will result in an enormous benefit on the operating cost side. If it is assumed that today it is often sufficient reason to change equipment if fuel consumption can be decreased by 8 or 10 percent, then one can see what kind of step forward the Do 228 promises the operator.

The market for aircraft in this category has its own laws. With highly successful sales of the Utility family, from the Do 228 to the Sky servant, Dornier has had ample opportunity to study these laws. The result is the Do 228.

The Wing Section

The two new Dornier models have a wing section that has never been used on an airplane before--if one excepts the TNT test vehicle. The designation of the new wing section is: Dornier A-5. Some prehistory: In previous years during the design stage of a new aircraft a suitable wing section was selected from one of the available wing-section catalogs. The majority of aircraft in use today employ NACA wing sections, which are defined more precisely by a four- or five-digit number. Laminar sections are recognizable by the serial numbers 63 or 64. The necessity of flying with even great fuel economy to save energy forced the development of new "individual" wing sections, sections that were custom designed for a particular purpose and not more or less "good for everything." The development of new specialized sections for particular categories of airplanes started in the early 1970s under the leadership of the recognized American aerodynamic expert Whitcomb. One of the results of his research was a new wing section series, which was given the designation GA(W) and was designed specially for General Aviation. The designation GA(W)-x stands for General Aviation Whitcomb. The first sections of this series are already in use at General Aviation, for example, the GA(W)-1 section, which is used on the Beech Skipper. Starting with the GA(W)-1 section, Dornier investigated the possibilities of further development on behalf of the Ministry for Research and Technology (BMFT). Work began in 1975 and revealed some promising aspects, that is to say, it appeared possible to achieve an improvement in maximum lift and also in the lift-drag ratio. Dornier investigated the effects of a new section of this type in actual flight. For a twin-engined airplane equipped with 2 200-hp engines, with a liftoff weight of 1,814 kg and a wingload of 94.5 kg/m^2 , an increase in maximum section lift of 20 percent and in lift-drag ratio during climbing of 4 percent would shorten the takeoff distance by 25 percent, improve the climb gradient on one engine by 32 percent and achieve an increase in range of up to 57 percent. If one compares the effort

which was formerly needed to achieve similar improvements in performance, the great value of this improvement in wing section can be quickly recognized.

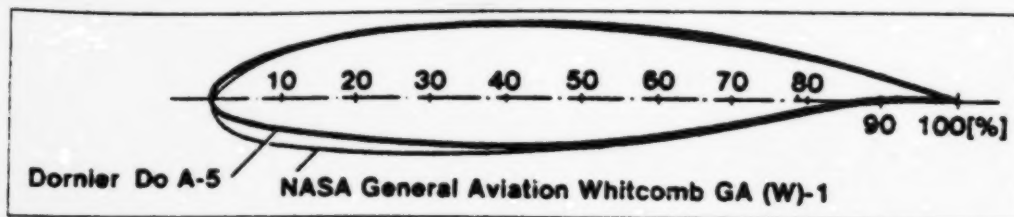
In order to realize the practical benefits of this improved wing section, Dornier first freed itself from the need to use the laminar section. It is true that the drag of NACA laminar sections using the so-called laminar depressions is extremely low, but this cannot be fully utilized in practice due to the intrinsic need for precise construction. There is the additional fact that in a twin-engined aircraft about 40 percent of the free upper surface of the wing is washed over by the propeller's wake, so that air does not pass over it in laminar flow.

Starting with these facts, two measures crystallized at Dornier, which lead to the new section with the desired increase in maximum lift and the sought-for improvement in the lift-drag ratio.

- An increase in the nose radius or the curvature of the nose
- An increase in the curvature at the rear of the wing section

Both these measures are already found in the GA(W)-1 profile, for which maximum lift without and with extended flaps is 0.3 and 0.4 higher respectively than the comparable conventional profiles.

Using the GA(W)-1 section as a starting point, Dornier then began optimizing the wing section, work which was finally brought to completion with the Dornier A-5 section. The A-5 section (see drawing) has a sharper curvature in the nose area and has a smaller nose radius.



As the result of a weight and cost analysis carried out for the new-technology wing, the section thickness was reduced from 17 to 16 percent. The Dornier A-5 section was complemented by a single-slot flap with a depth of 30 percent, the design of which resulted empirically from consideration of experience with flaps for supercritical wing sections. This was possible because both sections have in common a pronounced rearward curvature. In fact, the GA(W)-1 sections were a kind of spinoff from the development of supercritical profiles for aircraft operating close to the speed of sound.

With the development of the A-5 sections, the first and perhaps most important step toward the development of the TNT had been taken. For a number of reasons, Dornier decided on the high-wing method of construction in the design of the Do 228. Naturally, the possibility of taking over a large number of components from the previous Sky servant program spoke in its favor, but independently of this "considerable hereditary burden" there are a number of good reasons in favor of high-wing construction. One of the advantages is that in determining the dimensions

of the propellers from the point of view of efficiency and noise emissions, optimal figures can be sought without having to consider necessary ground clearance. This advantage must not be underestimated when seeking the highest possible overall efficiency.

The Do 228 is the first airplane to be equipped with a new-technology wing. In this respect also the high-wing layout offers advantages in construction, since the wing can be designed solely according to aerodynamic considerations and, for example, does not also have to accommodate the undercarriage.

For passengers, the relatively low-slung fuselage offers easy entrance and exit and a good view of the ground from all seats during flight.

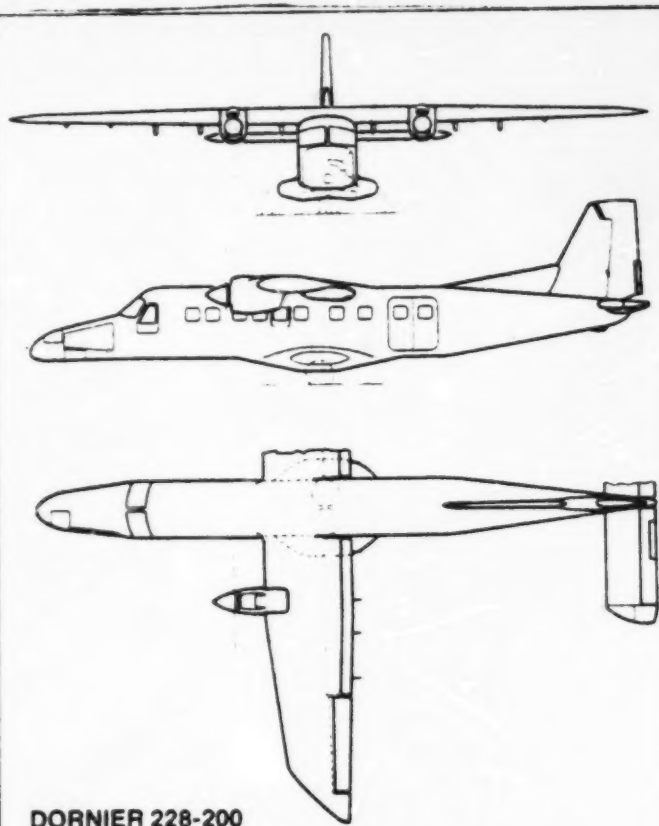
The rectangular fuselage cross-section was adopted from the Skyservant and has proved to be outstanding for an aircraft of this class because of its excellent utilization of space. Unfortunately, this fuselage design does not allow the Do 228 to be equipped with a pressurized cabin. This is not absolutely necessary for the typical applications for which the 228 is designed. In the short term, Dornier is not thinking of developing a new pressurized cabin, but in the course of the program it will certainly follow to supplement the progressive TNT.

Dornier selected the Garrett AiResearch TPE331-5 turboprop engine as the powerplant; it is known to be economical, nonpolluting and require little maintenance and was restricted to a takeoff power output of 715 shaft hp (ISA [International Standard Atmosphere] + 18° C). From a comprehensive test program using eight different types of propeller, a four-blade, adjustable pitch airscrew from Hartzell emerged as the best compromise and was thus the winner. The propellers can be feathered and reversed. Dornier was able to opt for a relatively large propeller diameter, 2.73 m, which has a positive effect on both efficiency and on efforts to reduce noise during flight. The overfly noise of the Do 228 can be described as very low at only 78 dBA.

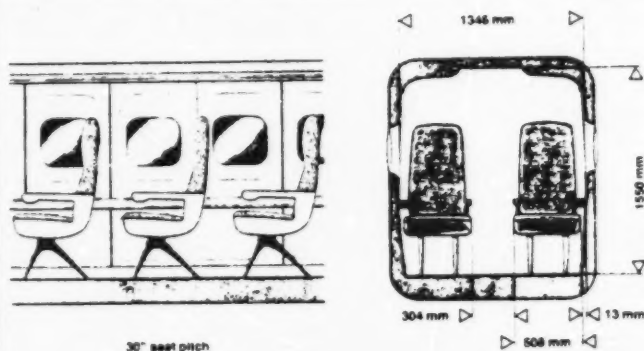
It should be noted that the undercarriage is designed for operation from minimally prepared airfields and it can be fitted with so-called low-pressure tires upon request. The steerable nosewheel is fitted with twin tires.

The multiplicity of possible variations in cabin layout is important for the customer. First of all, there is the choice between the 100- and the 200-version. The difference in cabin length is 6.33 m in the 100 and 7.08 m in the 200. Depending on the seating arrangement, the smaller version can carry a maximum of 15, the larger one a maximum of 19 passengers. All seats can be reached easily and comfortably from a central aisle. Even when boarding there should be no "pushing and shoving", due to the large double doors, measuring 1.28 x 1.34 m, located at the left rear end of the fuselage. There are two compartments for passengers' baggage, at the rear of the fuselage, adjoining the cabin, and in the nose section, directly above the nose wheel (indicated by "B" in the drawing).

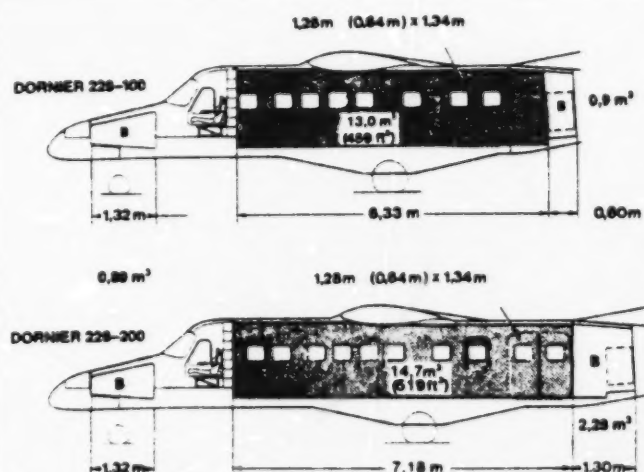
If the Do 228-200 is used as a freight carrier, an impressive cargo space of 14m³ is available.



DORNIER 228-200



30" seat pitch



The cockpit is normally intended for operation with two pilots and is accordingly equipped with dual controls. In principle, operation with only one pilot would be possible. Access to the cockpit is either through the cabin or through a separate cockpit door. Vision from both pilots' seats is outstanding.

From the outset the designers' efforts were directed at keeping the time required for the preflight check as short as possible. This principle can be detected everywhere in the design of the systems.

Steering the aircraft is carried out mechanically, as is rudder trimming. Elevators and aileron trimming are designed for electromechanical operation.

The engines are supplied with fuel from two independent tank systems. Each tank system in turn consists of 2 integral tanks per wing, designed for pressure-refueling, which together can hold 1,125 liters of fuel.

The leading edges of the wings and tailplane are provided with pneumatic deicing equipment, while the engine air intakes are deiced with hot air and the propellers are deiced electrically. A special separate system takes care of deicing the front windshield.

Taking everything together, the Do 228 promises to be an aircraft that has a number of advantages to offer the operator.

--Fuel savings of up to 30 percent through superior wing aerodynamics.

--A rectangular, fully usable, comfortable and spacious cabin with numerous possibilities for use and different arrangements.

--Good performance characteristics when using short and high-altitude airfields and in hot weather.

--A range of up to 1,065 nautical miles (1,970 kms) at maximum load.

--Low operating costs resulting from good fuel consumption and simple maintenance.

--Independence from ground installations.

--Long cabin life, designed for 30,000 flights without overhaul.

The design and the execution of the 228 program so far have shown that the German aircraft industry is capable of entering the world market in this area with technologically attractive products at realistic prices. It only remains to wish for Dornier that civilian applications are found for this new airplane family inside the FRG as well. Third-level air travel could profit immensely from it.

Dornier Do 228 Data Table

Manufacturer		Dornier	
Model		228-100	228-200
Engines		Garrett	
		TPE731-5 [as published]	TPE731-5
Power	kW	2 x 534	2 x 534
		= 1,068	= 1,068
	SHP	2 x 715	2 x 715
		= 1,430	= 1,430
Wing Span	ms	16.97	16.97
Length	ms	15.03	16.55
Height	ms	4.86	4.86
Cabin Dimensions			
Length	ms	6.30	7.08
Height	ms	1.35	1.35
Width	ms	1.55	1.55
Empty Weight	kg	2,798	2,908
Weight with Equipment	kg	3,193	3,393
Maximum Weight without Fuel (MTZW)	kg	5,400	5,400
Maximum Fuel Load	liters	2,250	2,250
Maximum Payload	kg	2,207	2,057
Maximum Takeoff Weight	kg	5,700	5,700
Cruising Speed at 10,000 ft.	KTAS		
	[Knots True		
	Air Speed]	233	233
	km/hour	432	432
Economical Cruising Speed at 10,000 ft.	KTAS	179	179
	km/hour	332	332
Rate of Climb			
on two engines	ft/min	2,050	2,050
	ms/sec	10.4	10.4
on one engine	ft/min	530	530
	ms/sec	2.7	2.7
Service Ceiling	ms	9,020	9,020
Maximum Range at Maximum Payload	km	1,970	1,150
Takeoff Run	ms	415	415
Takeoff Run to clear a 15 meter barrier	ms	525	525

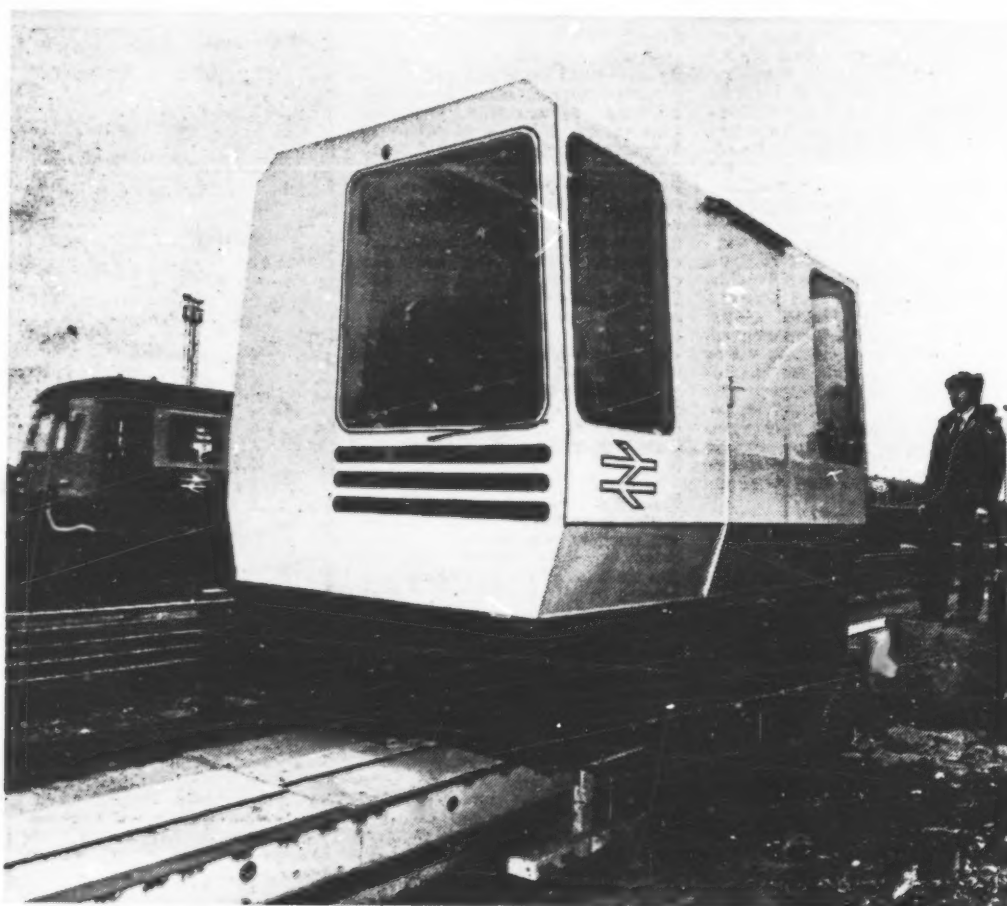
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CSO: 3102/372

TRANSPORTATION

MAGNETIC LEVITATION VEHICLE

Duesseldorf VDI NACHRICHTEN in German 19 Jun 81 p 16



[Text] This experimental driverless vehicle floats on a magnetic field. It is the prototype of a commuter transportation vehicle, which is to connect the new airport terminal in Birmingham with the railroad station and the National Exhibition Center. The car rides 15 mm above the guide rail, powered by a linear induction motor. The planned commuter service for Birmingham will consist of 3 cars, each with 30 seats and room for 48 standing passengers.

JPRS 79106

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West Europe Report

SCIENCE AND TECHNOLOGY

No. 75



FOREIGN BROADCAST INFORMATION SERVICE

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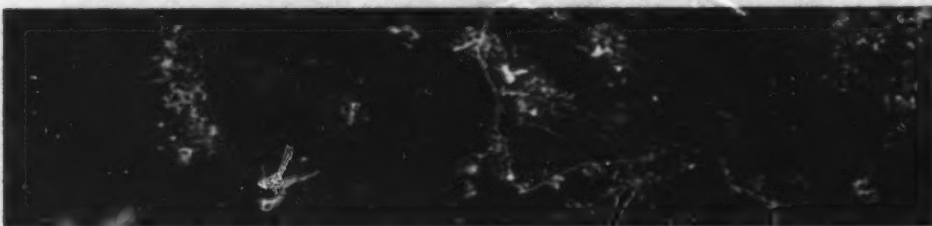
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ELECTRONICS

FRANCE'S SEMICONDUCTOR INDUSTRY ON DISPLAY AT EXHIBITION

Essen ELEKTRO-ANGZEIGER in German No 11, 1981 pp 5, 6, 8

[Article: "France's Semiconductor Takes Shape"]

[Text] Over 95,000 visitors came to Paris to the "Salon International des Composants Electroniques 81." From April 6 to 11 they were able to peruse the components, instruments and manufacturing equipment of almost 1,700 exhibitors from 37 countries.

Over half of the exhibiting firms came from abroad. The largest contingent was provided by France with 682 exhibitors, followed by the U.S.A. (360), and FRT (185), Great Britain (128) and Switzerland (88). Also, 63 Japanese firms came to Paris; last year it was only 39.

In spite of the international participation, the primary value of the Component Salon is for the French industry. Exporting is becoming much more important than importing. Until now the predominant exports have been passive components and hybrid circuits. In recent years, with help from the French Government, a domestic semiconductor industry has been established which is now exerting considerable pressure on the European market.

Semiconductors from France

As at each electronics fair so also in Paris, the booths of the American semiconductor firms were centers of attention; however, this year there were no spectacular announcements.

Less noticed, but probably of considerably more importance for product improvements, are the activities of the French semiconductor firms. Since 1977 the French Government has fostered the development of an independent semiconductor industry. To date FF 600 million have been distributed to 5 firms: EFCIS, Eurotechnique, Matra-Harris, RIC and Thomson CSF. Only firms in which French companies are majority shareholders are supported; thus, Motorola in Toulouse and Texas Instruments near Nizza are not included in the support plan.

The Government support program is still in force, initially conceived to run until 1982; however, the French Minister of Industry Andre Giraud has announced that the program will extend beyond that date.

Within the scope of the effort to establish an independent microelectronics industry, two new companies were founded: Eurotechnique and Matra-Harris.

On 11 April 1979, Saint-Gobain-a Mousson and National Semiconductor signed an agreement of cooperation creating a new semiconductor manufacturer, Eurotechnique, with 51-percent holdings by the French company Saint-Gobain-a-Mousson and 49 percent by National. Within a period of 5 years, FF 400 million will be invested. The goal is MOS production, including NMOS and XMOS circuits and CMOS and P²MOS components. In addition to memories and microprocessors, MOS circuits for the telecommunications and automobile industries are also planned.

The factory is located in Rousset-sur-Arc and presently employs 200 workers; by the end of 1984 this number will be 800. Production capacity is designed for a maximum of 50,000 silicon wafers; and the manufacturing equipment for 100-mm wafers can be converted to produce 125-mm wafers.

According to Eurotechnique's Application Manager Philip Maes: "The marketing strategy is to serve the broadest possible customer base across all of Europe." Eurotechnique will enter agreements with individual distributors as well as set up its own distribution network in the most important European countries. The French sales office was opened last year; distribution offices in Germany and Great Britain will be opened this year. The German distribution office, located in Munich, will employ 2 applications engineers.

The other newly founded firm is Matra-Harris which is owned 51-percent by the French concern Matra and 49-percent by Harris. It was officially established on September 6, 1979. Initially only CMOS circuits were manufactured; however, since the first of this year bipolar circuits, PROM's and IC's, for data communications are also produced.

In addition Matra-Harris concluded a second-source agreement with Intel on March 30. The first NMOS processors of the 8048 family will be manufactured in Nantes at the beginning of 1982. The agreement with Intel provides however for other processors as well. A common design center is also planned.

"Matra-Harris will also be active in the FRG," according to Marketing Manager Luc Joquet; negotiations with a distributor are almost complete.

In addition to a complete line of semiconductor memories, Matra-Harris also manufactures peripheral and interface circuits. Besides the 12-bit processor HM 6100, CMOS versions of the 8-bit /Kirdendall-effect/ controller 8048 will also be produced. The production program is rounded out with analogue components and IC's for telecommunications.

The two European semiconductor manufacturers still have to demonstrate how good they are, of course. The plan of the French Government to establish an

independent microelectronics industry has been proceeding satisfactorily thus far.

Thomson and RTC

Somewhat longer in the semiconductor business have been Thomson CSF and RTC. Also, the Thomson subsidiary EFCIS has been producing microprocessors and other IC's for some time. All three companies received support money from the French Government.

At the Salon the Semiconductor Division of Thomson CSF announced a series of new products. In the area of bipolar IC's, mainly driver circuits and control components were introduced; in addition, several IC's for radio and TV equipment were presented. The Government is supporting this bipolar production with FF 100 million.

Thomson CSF still manufactures mainly discrete semiconductors, concentrating on the strong sales area of power and signal components. Especially fast growth is anticipated in power semiconductors over the next few years.

The Thomson subsidiary EFCIS has a second-source agreement with Motorola. They have been building 8-bit processors for some time; now they are also manufacturing the 16-bit processor 68000. At the Components Salon EFCIS also introduced several interesting display processors.

The fifth and last firm supported by the Government is Radiotechnique Comptec (RTC). This Philips subsidiary manufactures primarily discrete semiconductors; however in Caen, integrated circuits are also produced--TTL/LS, CML and ECL as well as several linear circuits.

Among the discrete semiconductors RTC presented a LED made of GaAlAs.

Also shown were GaAs FET's and new optocouplers which are compatible with CMOS circuits.

Telecommunications

The French semiconductor industry has focused its effort on the development of circuits for the telecommunications industry. Four integrated circuits were developed by EFCIS and Eurotechnique and announced at the Components Salon. Simultaneously, it was announced that the two French companies have finalized an agreement with Harris and National Semiconductors concerning the production of these circuits. The integrated circuits involved are CODEC filters. These IC's will be deliverable in production quantities this year and in even greater numbers after 1982. Thus, worldwide standardized components from 4 different manufacturers are available, a development of great importance for the manufacturers of telecommunications equipment.

On almost all French booths the symbol of the European Quality Assurance System CEEC was to be seen. Yves Simmler President of the French Professional Association for Passive Components (SYCEP) lamented the fact that the German end users largely ignore the CEEC system. In his opinion this quality assurance system has several advantages compared to the American Military Specification System. The products are not only tested by the manufacturers but are also continually tested by independent surveillance centers. In many cases receiving inspection can be greatly simplified and made cheaper. Also, the products which fail the tests are publicized. But it is not just the users who profit by this quality assurance system; European component manufacturers also gain a competitive edge over their counterparts from the U.S.A. and Japan.

9160

CSO: 3102/387

ENERGY

EDF TO SPEND OVER HUNDRED MILLION ON NEW ENERGIES

Paris AFP SCIENCES in French 25 Jun 81 pp 3-4

[Text] PARIS--According to the management of the French Electric Company (EdF), this organization will spend, this year, 111.8 million francs for new energies. This amount breaks down into two categories:

- 84.4 million francs for new energies in the strict sense (solar, geothermal, wind energies)
- 27.4 for energy derivatives; that is, the use of thermal waste products, steam production, hydrogen.

More than 70 million francs will be used for two developments:

- the THEMIS solar power plant
- the Bouillante geothermal power plant in Guadeloupe

As for the other expenditures, emphasis will be placed on the very important research effort carried out in two areas:

- The mixed or joint production of heat for industry from nuclear power plants (from 2.4 to 13.2 million francs from 1979 to 1981),
- The use of solar energy in the industrial and agricultural (biomass) sectors, which has gone from 0.3 to 3.4 million francs from 1979 to 1981.

Expenditures by EDF for New Energies and Energy Derivatives
(in thousands of current francs)

	1979 Real <u>Expenditures</u>	1980 Probable <u>Expenditures</u>	1981 Anticipated <u>Expenditures</u>	<u>z</u>
I- New Energies				
1- Solar Energy				
1.1 Use of solar energy in residential and tertiary sectors	4410	2535	2955	3.5
1.2 Production of electricity from solar energy (basically project THEMIS)	14665	3400	57650	68.5
1.3 Use of solar energy in the industrial and agricultural (biomass) sectors	335	1350	3400	4
2- Geothermal Energy (Bouillante)	1700	2700	13700	16.5
3- Wind Energy (Ouessant wind motor)	1400	1155	1800	2
4- Energy Storage Except Hydraulic Storage	3200	1600	2200	2.5
5- New Techniques for Using Fossil Fuels (Gasification...)	95	190	2680	3
TOTALS	25805	12930	84405	100
II- Energy Derivatives				
1- Hot Water or Steam*				
1.1 Recovery of low temperature thermal waste products from power plants (applications in agriculture, fisheries, and forest development)	6900	4330	7230	26.5
1.2 Mixed or joint production of heat and electricity - transmission and distribution of heat - project studies	2415	3800	13240	48.5
2- Hydrogen	4200	5200	6900	25
TOTALS	13515	13300	27370	100

*Excludes applications of steam or hot water in industry but includes studies on supplying steam to industries.

9816

CSO: 3102/388

ENERGY

EDF SAYS NO MORE THEMIS-TYPE POWER PLANTS IN FRANCE

Paris SEMAINE DE L'ENERGIE in French 22 Jun 81 p 9

[Text] "EdF does not plan to construct any more Themis-type solar power plants in France--" was the declaration made last Thursday by Mr Marcel Sagot, regional director of EdF's Alpes-Marseille equipment region.

"As long as we don't know how to concentrate the diffused energy, this technology costs much too much," he stated during his Thursday visit to the plant site at Targasone (Pyrenees-Orientales). "The basic cost comparisons are unsatisfactory. Given current economic conditions, Themis-type solar power plants cannot constitute a basic energy source for France. Right now, a KWh costs 5 francs, compared to 15 centimes for nuclear, 42 centimes for those run on coal-burning power plants, and 47 centimes for those run on fuel oil."

Themis is a solar power plant with a tower and a power output of 2,500 KW. A field of 200 heliostats (large mirrors) focuses solar rays onto the boiler located at the top of a tower. The heat collected in this way is converted into electricity by a water-steam cycle which runs a standard turbo-alternator unit.

Work on Themis began in October 1977 at the Targasone site, which has an altitude of 1700 meters and was chosen because of its exceptional amount of sunlight (2400 hours/year); the project will be completed in November 1981. The investment runs to more than 128 million francs and is shared as follows: 13 percent jointly by the Department of the Pyrenees-Orientales and the Languedoc-Rousillon region, 39 percent by the Solar Energy Commission, and 48 percent by the French Electric Company. At EdF, there is no great enthusiasm for this sort of operation in France. When it's connected to the grid, the sale of the 3 million KWh currently produced won't even cover the salaries of the people allocated to run it.

The plant could be much more profitable in warmer regions, especially in Central Africa and Australia. Thus Themis, an expensive item in France, could find a better market through export.

9816

CSO: 3102/388

ENERGY

UNIQUE WIND TURBINE EXHIBITED, NOW OPERATING

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 9 Jun 81
pp 415-416

[Article by Peter C. Reimers]

[Text] At the 1981 Hannover Fair, there was the first showing of a large wind turbine which is supposed to ensure an economical generation of electricity through its extremely high rotary speed. This unit, the only one of its kind in the world, was installed after the fair on a tubular steel tower 30 meters high near Stoetten in the Swabian Mountains (Figure 3).

The Voith Wind-energy Converter WEC 300 starts up even at wind velocities below 3 m/s, and from 4.5 m/s on it begins to deliver electric power. The full power of 316 kW is reached at 8.5 m/s. In a storm, the unit shuts off (runs on "sailing" mode) so that no damage can occur. Since with this turbine economical results can be achieved even at relatively small wind velocities, its use is feasible also in regions which do not offer such optimal conditions as are found along the coast or in the mountains.

The attempts made up to now to convert wind energy into electric power have led chiefly to rather small units. Wind turbines with installed capacities up to the 10-kW range are to be found again and again on the market--and larger units are being planned and developed. The Voith Wind-energy Converter WEC 300, with commercially reasonable dimensions, is the first such turbine of this size to be equal to the requirements made with respect to running characteristics, self-regulation, and efficiency. Its electric power (380 V, 50 Hz, three-phase current) is so constant in terms of voltage and frequency that it can be fed directly into the distribution network of the relevant electricity supply company, a step which has already been authorized.



Figure 3. Nose, 12 tons in weight, of the new Voith Wind Turbine. To this "nacelle" is attached the two-bladed rotor, which has a total length of 52 meters. The solar cells which supply the unit's measuring equipment with electricity can be seen clearly. The complete large turbine set-up is shown in the illustration.

12114
CSO: 3102/360

ENERGY

GERMAN-ARGENTINE WIND-ENERGY CONVERTER OPERATING

Duesseldorf VDI NACHRICHTEN in German 19 Jun 81 p 28

[Article by A. Fritzsche]

[Text] On the coast of Patagonia, one of the most windy regions in the world, a 20-kW wind-energy converter with a vertical rotational axis (Darrieus design) was placed into operation around the middle of April. On the German side, the work for this German-Argentine joint project is being performed by order of the federal minister for research and technology (Identification Number ET 4403-A).

On 14 April, a wind-energy converter with a vertical rotational axis, built in accordance with the Darrieus principle and with 20 kW of rated electrical output, rotated for the first time on the South American continent. The site lies on the airport grounds of Comodoro Rivadavia, a city in Patagonia, 1,600 km south of Buenos Aires. Following the preliminary work by the Argentine partner-- design and construction of the foundations, laying of the underground connections, setting up of the power sink and wind-measuring equipment--only 4 days of joint work were needed for the final assembly of the mechanical and electrical components.

At first the completion of the facility and the functional testing were delayed by a sandstorm, heavy rainfall, and then by windlessness. Nevertheless, by 21 April the complete demonstration of the mechanical and electrical functioning of the facility in the entire operational range could be given and the facility could be turned over to testing. Initial test runs under varying wind conditions lasting several days showed that the facility--as was calculated--starts to operate at only 4 m/s and that the rated electric power exceeds the design value by about 10 percent.

At the end of 1978, within the framework of German-Argentine agreements on carrying out joint research and development projects, Dornier System of Friedrichshafen was directed by the federal minister for research and technology to start on the development and manufacturing of a wind-energy converter having 20 kW of rated power, a rotor diameter of 12 m, and a vertical axis of rotation. This work was based on design and computational data from a previous project involving the construction of a wind-energy converter with a rotor diameter of 5.5 m.

Fundamental Data of the Facility

Rotor diameter	12 m
Total height of the facility	17.5 m
Effective rotor surface area	93 m ²
Blade coefficient (profile NACE 0015)	3 m
Profile depth	320 mm
Start-up wind velocity	4 m/s
Nominal wind velocity	10 m/s
Shut-off wind velocity	22 m/s
Survival velocity	65 m/s
Nominal rotational speed	70 rpm
Maximum rotational speed	150 rpm
Rated power, electric	20 kW
Maximum power, electric	25 kW

The division of labor was such that the Argentine partner, the Comision Nacional de Investigaciones Espaciales (CNIE), Buenos Aires, undertook the determination of wind conditions in the area of the selected site and the general supervision, so that by and large all the manufacturing methods employed in the construction of the facility can be executed later by Argentine industrial outfits as well. Through the collaboration of Argentine engineers in the project on the premises of Dornier System, an almost problem-free site preparation (foundation laying and wind-measuring equipment) and a rapid final assembly was ensured, and preparations were made for the testing phase, in which the German side will take part only in a supporting role.

The Institute for Climatology and Meteorology at the University of Hannover analyzed the wide-ranging meteorological conditions of Argentina, analyzing in particular depth the southern portion of the country and the site of the facility. This investigation is in the nature of a model which will form the basis for further projects.

It is the goal of this project to test the technology of a wind-energy converter with a vertical rotational axis in a power range which lies above that of commercially available small facilities, allowing it to make a substantial contribution to the energy supply for autonomous consumers in windy regions. On the socioeconomic plane, this bilateral project fits into national Argentine programs for the long-range improvement on a broad basis of the structural situation of the southern part of the country, to be accomplished with the support of German technology.

Lightweight Blade Construction

As part of the development program of the Federal Ministry for Research and Technology, this project does much to foster the trend of using wind-energy converters with a vertical rotational axis in the domain of small outputs--a development which is very important as well to the national wind programs of the United States, Canada, Sweden, Great Britain, and the Netherlands, which involve large facilities up to the MW range.

As a result of its characteristic of having a vertical rotational axis, as compared to the familiar wind-energy converters with a horizontal rotational axis, the functioning of this facility is independent of wind direction. Initial test results on large American units with a horizontal rotational axis have shown that the cumulative effect of their imperfect adjustments to the momentary wind direction is definitely not irrelevant in terms of energy loss. The Darrieus rotor (3 blades) runs in an upper and lower bearing.

The upper bearing and thus the rotor itself is held in place by three guy ropes anchored to the ground. In order to ensure pre-tensioning, prestretched solid material was selected. The rotor blades, designed to form a symmetrical aerodynamic profile, were extruded from an aluminum alloy (AlMgSi) and bent in a blade shape which corresponds to the jump-rope curve (troposkiene). This shape allows a particularly lightweight blade design, since the bending forces are reduced to a minimum. The attachment of the blades to the rotating tower at the top and bottom is rigid in the circumferential direction, so that the torque can be transmitted, and flexible in the plane of the blade in order to offset the bending stresses. For reasons of ease of transport and assembly, each rotor blade consists of three sections, which are connected together in the final assembly at the erection site by means of bolts.

In order to limit the rotational speed of the rotor, spoilers were incorporated in each rotor blade as aerodynamic brakes. They lie in the equatorial plane of the rotor, since their effect is greatest here. The spring pre-tensioning of the spoilers is adjusted in such a way that from about 100 rpm on, they begin to depart from their zero position through centrifugal force, thus generating the aerodynamic resistance.

The start-up of the Darrieus rotor, whose blades need not be altered in their angle of pitch, can be achieved by aerodynamic or electric means. For the facility at Comodoro Rivadavia, two Savonius rotors were chosen which are positioned in an aerodynamically favorable way at the upper and lower zones of the rotor. With a three-bladed design for the Savonius rotor, and moreover with the second being twisted by 60°, the greatest possible uniformity in the start-up torque is achieved for every wind direction. Wind-tunnel tests with a smaller rotor have shown that within the range of measurement accuracy, no detectable loss of power of the Darrieus rotors due to the Savonius rotors could be found.

The tower is an aluminum tube (AlMg 3) which is 12 meters long and which is spiral welded in one piece. Relatively large numbers of these structural units are used in process engineering. By way of the lower rotor bearing, the base structure absorbs the forces which result from the rotor weight and the guy ropes. Moreover, it also serves as a protective housing for the components of the energy transfer, such as brakes, drive shaft, coupling, gear unit, generator, and control and monitoring units.

The electrical concept is based on the consideration that the maximum energy is utilized when--regardless of the wind velocity--the system is run within the operating range at an optimal total efficiency at all times. Since depending on the wind velocity the maximum efficiency, and thus also the appropriate output, is found at differing rotational speeds, the characteristic

of the generator must be shifted for an optimal matching of maximum to maximum. The functioning of this peak-value controlling lies in the fact that the energizing of the generator is chosen automatically in such a way that this generator furnishes a maximum current. Via a rectifier on the output side, the synchronous generator--which is coupled to the rotor by way of a gear unit which has a fixed gear ratio--lies at the relatively constant potential of a battery. The peak-value controller continually superimposes on the basic excitation current a small amplitude of low frequency. Through its modulating of the generator speed, this modulation of the excitation current causes a modulation of the power output. The matching accuracy is within about 1 percent of the actual instantaneous maximum. The battery is designed only for the floating operation of brief power fluctuations. A standard line voltage (380/220 V/3 phase/50 Hz) is generated by a static converter. In the initial development stage, the energy is supplied to a lighting and heating system. The equipment for the control, energy processing, data logging, and monitoring are housed in a dust-proof container.

Although it only proved possible to extract the energy supplied by the facility to the nominal operating point by means of the parallel operation of battery charging and the sink--an increase in power would have been possible by using a larger sink--the entire operating range could be gone through several times in association with important operational situations. A wind velocity of 4 m/s is sufficient to cause the rotor to start up with disengaged coupling, and an only somewhat greater velocity is needed when the gear unit and generator are connected in. At a rotational speed of about 40 rpm, the generator begins to deliver energy, and at 70 rpm the rated power is reached.

The portion of the data initially evaluated showed that the band of measuring points follows the maxima of the calculated characteristic curves. The coordinating of output and wind velocity will remain problematic even with this still relatively small facility, although gusts were observed which increased the rotor speed even though they did not perceptibly register on the anemometer. The maximum value of 65 m/s given by the weather service for this site was taken as a basis in the design as the survival velocity for the facility. During the assembly, velocities of 120 km/hour or 33 m/s occurred, and these are not considered unusual.

Spoilers Brake the Speed

The coincidence of the calculated critical rotational speeds with the observed occurrence of very weak oscillations of the guy ropes below the operating point is one of the pleasant surprises in view of several problems discussed in the technical literature. At about 90 rpm, all the spoilers begin to open evenly. In the load-free run-up curve, the drop in the increase of rotational speed is clearly recognizable. As a redundant speed limiter and stopping brake, at 120 rpm an electro-hydraulically driven disk brake engages, which brings the rotor to a stop within 15 seconds, inclusive of reaction time. Perhaps certain adjustments may still have to be made in connection with the controller setting, so as to match the time constant of power maximization with the dynamic behavior of the rotor.

The Argentine partner CNIE will install an automatic recording device for the operational and meteorological data and will improve the utilization of the electric power in a way appropriate to the quality provided by the facility. According to the planning of the project, the testing phase will run until February 1982, from which both partners expect extensive data, which will be important to the continuation of development in this sector.

12114

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ENERGY

CONFERENCE ON USE OF WOOD FOR ENERGY SHOWS STATE OF ART

Paris INDUSTRIES & TECHNIQUES in French 1 Jul 81 p 12

[Article by J. Nenin]

[Text] Gasification, hydrolysis, chemical extraction, a thousand and one methods are available to process wood and wood by-products. Specialists met in Bordeaux to review the situation.

In the area of wood, France has an enviable position. Forests cover 13.5 billion hectares of the nation's territory, or 45 percent of the total wooded area for all countries in the EEC (European Economic Community). Both from the raw materials and from the energy standpoint, this recently "re-discovered" natural resource represents a much greater wealth than its conventional uses had led to believe. From the energy standpoint, one ton of wood is equivalent to 313 liters of fuel oil. It is therefore anticipated that by 1985, wood will provide 2.5 million tons of petroleum equivalent which will be added to the 2 million tep already produced. By itself, the use of wood by-products and residues offers a wide choice of possibilities. The production of lumber for construction produces a large amount of residues, about 40 percent.

In order to review the status of these possibilities, the Association for the Promotion of Research and Innovation in Industry has just organized, with the assistance of the Chamber of Commerce and Industry of Bordeaux and the Landes Region, a one-day meeting with the object of reviewing the "utilization of wood by-products and residues." About 80 specialists attended.

Wood gasification is a popular subject. The Battelle Institute has just completed the development of a double fluidized bed prototype. Along the same lines, Mr Chrysostome, of Creusot-Loire, presented an experimental gas generator for the production of methanol. Its fluidized bed consists of sand with grain diameter between .5 and 2 mm. The cylindrical device has a .20 m radius and is 4 m high. Wood pyrolysis is performed at 800 to 1000°C and the resulting tar is immediately cracked and gasified by churning with oxygen under a pressure of 10 to 30 bar. Methanol synthesis is performed using a catalyst after purifying the gas and adjusting its composition (the molecular ratio of hydrogen to carbon monoxide must be equal to 2). Since the transformation is not yet complete then, the synthesized gas is recycled after having recovered the methanol already produced. On his part Mr Molle, of CEMAGREF, mentioned that a method for the heating of private

residences is being developed at the National Center for Study and Experimentation of Agricultural Machinery. It consists in producing gas from wood or straw in a small, automatically-fed gas generator. The gas produced in this manner is then burned using a special burner, inside the existing oil or gas furnace. This considerably reduces the initial investment. He also mentioned the appearance of new carbonization techniques applicable to products not previously concerned by this transformation method, such as sawdust and straw. Since these products consist of smaller pieces than the usual wood logs, they do not allow circulation of the hot carbonization gases as in conventional methods.

In the area of hydrolysis of ligneous and cellulosic products Mr Raymond, of Bertin Company showed that the best method consists in selecting a low-cost raw material (such as residue), and in concentrating the R & D effort on improving these methods. With this objective in mind, his company has made the proposal to the Ministry of Industry to build a pilot installation. The method used would be hydrolysis using diluted sulfuric acid under high pressure and temperature applied to ligneous and cellulosic products such as wood, straw, corn stalks, etc. Sugar-bearing juices obtained would be used for the production of gasohol by acetobutylic fermentation, of chemical ethanol by ethylic fermentation, and other compounds.

For Mr Pommier, Director of the Pine Industry, the analysis of the different compounds which can be extracted from pine bark shows the richness of this residue in phenolic products. These products represent 40 percent of the total bark weight and can be easily extracted using soda at 1 percent concentration. From the mixture obtained, it is possible to extract formo-phenolic resins which have an immediate outlet, particularly in the production of adhesives (plywood, pressboard, etc.)

Wood residues may be used in the wood industry itself, particularly as construction lumber. Mr Mercier, an Engineer at the GREF, has conceived a modular dryer for the Monts de la Gresigne Sawmill (Tarn). The device has a capacity of 200 m³ of wood logs (to dry 1,000 m³ a year) and will operate using 50 tons of dry sawdust. The additional energy required (about 50 percent) will be provided by integrated solar heaters located in the walls and roof of the building. This system will compete not only with oil and gas drying, but also with the compression heat pump which was considered the most satisfactory solution until now.

As Mr Leonard, of the Pine Cellulose Company state, nothing should be neglected. Along with other concerns, his company has been participating since 1975 in studies on the recovery of stumps of Maritime Pine in timber land. They have just demonstrated that stumps are one of the most accessible resources offered by woodlands, particularly for the production of pulp. This is especially interesting since stumps constitute obstacles which appreciably increase the cost of reseeded (by at least one third). Finally, Mr Lebesgue, of Multibio Company, has underlined the interest presented by some wood residues and by-products in the production of compost (a fertilizer which accelerates growth in some species). A return to the source, in other words.

ENERGY

BRIEFS

NATIONAL WIND-POWER CENTER--Lannion - Creation of a wind-power center in Lannion - The city of Lannion (Cotes-du-Nord) has been chosen by the Solar Energy Commission as the site of a national wind-power center, it was learned from generally well-informed sources in Lannion. The center will be available to industries and development labs. The mayor, Mr Jagoret, was notified the previous day by the Commission. The exact site has not yet been officially selected but, according to well-informed sources, could be on the coast in the area of Trebeurden. The geographical location of the city and its favorable industrial environment were emphasized when the city presented its candidacy. [Text] [Paris AFP SCIENCES in French 2 Jul 81 p 38] 6445

CSO: 3102/390

SCIENCE POLICY

NEW RESEARCH MINISTER OUTLINES INTENTIONS

Paris AFP SCIENCES in French 2 Jul 81 pp 1-3

[Text] Paris -- The government will undertake "an unprecedented effort" in scientific and technological research, emphasizes Mr. Jean-Pierre Chevenement, minister of state, minister of scientific and technological research, in an interview granted to the French News Agency.

In order to attain the goal of raising national research and development expenditures (DNRD) to 2.5 percent of the GNP (gross national product) in 1985, 80 billion francs (in constant francs, and taking all expenditures together: public and private, civil and military) should be dedicated, in that year, to scientific and technological research. This figure was around 50 billion in 1980.

This effort cannot be successful without the "active participation" of private enterprise which, today, accounts for 40 percent of the total expenditures. "The great majority of businesses, which will remain private, will have to make a significant effort in the area of applied and technological research," judges Mr. Chevenement.

"To that end," explains the Minister, "the project carried out by the regionalized ANVAR (National Agency for the Valorization of Research) must be continued and intensified, whether it means aids to innovation, subsidies for innovation, or new procedures to be perfected. I'm also thinking about reduced loans, specially reserved for research and development investments."

Will private enterprise follow that policy?

"Let me point out," responds Mr. Chevenement in that regard, "that of the 22 billion francs which the business sector spent in 1980 on research and development, more than 12 billion francs were advanced by businesses which are today on the list of organizations to be nationalized. By itself, the Thomson group devoted more than 3 billion to research and development, which places it at the head of private businesses."

The scientific community, on one hand, and Parliament, on the other, "will be closely associated with the great scientific and technological choices which the government will make," Mr. Chevenement is quick to stress. That's why a great national conference will be held in the fall to discuss those choices. The organization committee of this conference will be formed in the near future. The scientific program law will be submitted for examination by the deputies in 1982, so that it may take effect in 1983.

On the controversial problem of guardianship of the great research organizations (that is, to which ministries, on the basis of their missions, should these organizations be attached), Mr. Chevenement explains that "the decree for allocating these guardianships has already been approved by the Council of Ministers. It's a matter of days before it appears in the official Journal."

"The decree states that the total credits authorized for research and technological development organizations will be part of my ministry's budget package. As important as this arrangement may be, it still leaves open the question of the guardianship's administrative organization."

"My philosophy is simple," declares the Minister on this point. "You have to encourage every useful relationship; in short, cover the territory and choose the solutions best suited to each of the organizations."

And to illustrate a specific case, the ARIANE program, which features the pre-eminent National Center for Space Studies (CNES), Mr. Chevenement answers in regard to the decision which must be made about ARIANE-4 (a launcher twice as good as the one just launched successfully at Kourou): "The Council of Ministers has already favorably considered the subsequent development of the ARIANE program. Soon, I intend to submit the file on the development of the ARIANE series. It is fitting, it seems to me, that the decision be made next at the governmental level, either a council at the Elysee palace, or in an interministerial committee."

On the international scene, Mr. Chevenement believes that cooperation must be increased and, in particular, in European countries themselves, where there is a vast area ready for this cooperation.

"I'm planning to meet very soon with my counterpart of the Federal Republic of Germany, Mr. von Bulow, and I intend to make a complete review of all the possibilities which are available for strengthening the already close ties which exist between the two countries in scientific and technical matters."

As for the developing countries, Mr. Chevenement considers that "there you have an important aspect of our policy which must be one of scientific research which is capable of responding to the problems encountered in France and the developed countries (such as the energy crisis, the competitiveness of businesses, the changing of work conditions, public health policy, etc....), but which takes into account the needs of the developing countries. What I have in mind is solar energy, fisheries, agronomy, bio-technologies, telecommunication satellites."

"Generally speaking, it's a question of making available to those countries the knowledge potential accumulated in the great industrial centers: in the United States, Europe, Japan, and the Soviet Union. For historical and geopolitical reasons, Europe has a stake in this, and its mission is to develop a grand strategy to make available the knowledge and technological potential built up in Europe over several centuries, often -- we should remember -- at the cost of exploiting other regions of the world."

To the last question: Will you have the political authority to act, because there are numerous precedents of promises which were not kept?, Mr. Chevenement answered: "If Francois Mitterrand did me the honor of entrusting me with responsibility for this sector, it's undoubtedly because he considered scientific research to be too serious a matter to be entrusted to anyone other than a politician."

SCIENCE POLICY

PROGRAM TO BE SET UP FOR RESEARCH, TECHNOLOGICAL INNOVATION

Paris AFP SCIENCES in French 9 Jul 81 pp 1-2

[Text] Paris. A multi-phased program of laws for technological research and innovation. In his programmatic speech delivered on 8 July to the National Assembly, the prime minister, Pierre Mauroy, confirmed that a multi-phased program of laws for technological research and innovation would be introduced in spring 1982. That same day, having been invited to a luncheon of the Scientific Journalists Press Information Association (AJSPI), Jean-Pierre Chevenement, secretary of state and minister of scientific research and technology, provided fuller information on what he had already said, elsewhere and on an earlier occasion (see the AFP-Sciences issues since No. 264 of 27 May 1981).

This multi-phased program of laws will be closely incorporated with the 5 year plan envisaged for the years 1984-88, but a certain number of measures in keeping with the program will appear already in the general provisional plan (and even in the extraordinary credits of the national budget which will be voted on as early as this session of the Assembly) which the government will apply to the 1982-83 period.

The program of laws which, apparently, will include seven categories, will define on the one hand the government's general strategy for ensuring that the national research and development effort reaches 2.5 percent of the PIB [Gross Domestic Product] towards 1985, and on the other hand will determine the principal scientific options and technological choices which command the future, and also the means for arriving at them.

One may say that among the seven categories one will find in one form or another the 10 topics which will be discussed during the national conference on research and technology which will be held about 15 Jan 1982, i.e., after the fall session of Parliament.

The major topics--it is still a matter of an outline whose contents and definitive structure will be determined in the coming weeks--are the following:

1. The scientific options and technological choices which command the future.

2. Technological and scientific research and a new development model.
3. Institutions; the organization of research and technology in France.
4. Industrial research.
5. Research, technology, and major operations finalized.
6. Research and major operations finalized.
7. Scientific employment policy.
8. Means of implementation.
9. Research and communications; scientific information, research, Parliament, and public opinion.
10. Science and ethics, the responsibility of the scientist.

Chevenement stressed that this national conference must come up with concrete propositions concerning:

- the major objectives to be reached,
- realization programs,
- courses of action for the minister of research and technology, organizations, and the leading participants in research,
- institutional innovations.

The organizational committee of the conference--presided over by Francois Gros, head of the Institut Pasteur [Pasteur Institute], charged with representation to the prime minister--together with the rapporteurs should be set up between now and 16 July. The orientation document of the conference will be ready by the end of July. It will be widely distributed beginning 1 September, concurrent with the setting up of the organizational committees of the regional assizes which will precede the conference, so as to allow the broadest participation of the scientific community and of the different socio-economic partners in preparation for the conference.

These regional assizes are planned for 1 October to 15 November 1981. It is to be noted that a secretary for each of these assizes will be chosen from the regional correspondents of the DGRST [General Directorate for Scientific and Technical Research], the regional delegates of ANVAR, [National Association for the Valorisation of Research] or noted scientists.

9824
CSO: 3102/396

TRANSPORTATION

ALCOHOL-FUELED TRACTOR ENGINE READY TO BE MARKETED

Paris LE MATIN in French 25 Aug 81 p 18

[Article by Pierre Bauchenot and Francois Gandouin: "The Alcohol-Fueled Motor Enters the Campaign"]

[Excerpts] What could be more commonplace than a tractor, in a field, on a summer day? And yet, the tractor being developed, proudly and at the same time anxiously, by Georges Agache, its inventor, is not an ordinary tractor. Under its gleaming frame, the good old standard diesel has been replaced by a single cylinder, 25 hp motor running on alcohol. It makes the same noise and is used for the same things, but with its single cylinder, this new motor, according to its builders, develops as much power as the original standard two-cylinder motor and has an equivalent thermal efficiency. In practical terms, this motor, which is smaller and lighter than its competitors, ought to consume less energy to produce the same amount of power. It has an advantage which is not yet proven but which will eventually be decisive; it runs on alcohol. Ethanol, with a sugar base (beet or cane) and methanol produced from biomass and coal are forms of industrial alcohol, which is easy to produce, especially for a large agricultural country. This has been a constant preoccupation of the Germans, and the Brazilians are already widely using alcohol from sugar cane. But the procedure developed by Volkswagen-Brazil is a compromise; the motors which they use still need gasoline, at least for starting. Georges Agache's motor is designed to run exclusively on alcohol. Neither a far-fetched gadget nor the invention of the century, the Moteurgaro does not claim to revolutionize the world's economy. But it can be one of several ways to respond to the energy challenge. The product of 30 years of passionate work, it is an interesting example of innovation and cooperative planning in the French style.

Neither a diesel nor a conventional motor, the Moteurgaro is a new system developed from existing blocks, and designed to use either ethanol or methanol. Made one at a time, it would cost up to 10,000 francs. But mass production could bring the cost down to the neighborhood of 1,000 francs. The problem is the supply of basic machinery available on the national market. There are virtually no French manufacturers of farm or industrial diesels. Out of 70,000 such motors sold each year, scarcely a thousand come from French factories. Even Renault tractors are equipped with German mechanisms. Agache and Chenesseau do some work on Alsthom motors (one of them was exhibited at the Inova show, last April). But they concentrate on German, English, or American motors. "As for our being able to produce the entire motor block by ourselves, that's a task which far exceeds our financial capabilities, explains Jean-Paul Chenesseau. Right now, we've got to be satisfied with conversion. The

program is going well. I saw the first motor run last September, and we'll be able to meet the demand on a regular basis at the end of the year." As a matter of fact, the first tractor has just been sent to Mali for testing.

If it performs successfully, a hundred or so machines could be ordered quickly. One reason is that Mali, economically strangled by the increase in oil prices, has a compensatingly large surplus of ethanol production. The third world obviously constitutes a natural market for the alcohol motor. Another reason is that agricultural waste and all the by-products of biomass make it possible to obtain fuel from decentralized sources and cheaper than imported oil. Numerous countries are interested in this type of fuel. India is especially interested, because renewable energy obtained from biomass requires both simplicity of technique and abundant manpower.

In the industrialized countries, the problem takes a different form. It's hard to imagine that alcohol will be used anytime soon for private cars. To do that, service stations would have to be specially equipped, and in France there are no fewer than 10,000 selling locations. Therefore, in the near future, alcohol can be used only for "captive fleets": taxis, mass transit, industrial vehicles, which can return for refueling at a small number of distribution points. But, obviously, the most important use of the alcohol motor is in agriculture. It's in the fields, where biomass can easily be converted to energy, that this type of propulsion can immediately be turned to profit. It could also be one answer to the difficulties of farmers who are directly hit by the price hike in petroleum products. Out of 100 million tons of oil imported by France each year, 20 million are used to satisfy transportation needs, of all sorts; and out of those 20 million, a good third is used by agriculture. Someday, perhaps, alcohol will, at least to some degree, take the place of the gasoline or the fuel oil burned in tractors and combines. Coastal fishing could also benefit from this type of propulsion, because algae constitute a good raw material for producing methanol.

The team of Agache and Chenesseau has no dearth of ideas for finding markets for alcohol motors. But at present there is a serious obstacle to mass producing them; compared to the potential demand, there is an almost complete lack of industrial capacity to produce industrial alcohol in France. The reason is that transportation is still in an "oil for everything" status. Indeed, it is against the law to put anything else in your gas tank, with one exception, up to now, for the LPG (liquified petroleum gas) parsimoniously distributed in the South-West. At the beginning of 1981, Andre Giraud, then Minister of Industry, launched the "Carburol plan." It's goal was gradually to put on the market a mixture of 90 percent gasoline and 10 percent alcohol, for use in automobiles.

This was an effort which, when fully implemented, would save around 1 million tons of oil, which is 1 percent of our petroleum production. More intensive use of industrial alcohol as fuel would undoubtedly be rather costly, at least at first, since considerable investments would have to be amortized. But greater use would lead to savings in foreign exchange and would enhance the nation's energy independence. We're not quite there yet. And the development and use of alcohol require at the same time a political will and favorable economic conditions. For a long time, the alcohol motor project remained tucked away in a drawer, because there wasn't any fuel. And alcohol wasn't produced because there weren't any motors adapted to use it. It was difficult to get out of this vicious circle. A first step has just been taken.

TRANSPORTATION

BRIEFS

HIGH-SPEED TRAIN INAUGURATION--Dijon. Official inauguration date of the TGV. The official inauguration of the high-speed train (TGV), scheduled to go into service 27 September, will take place a few days before that date at the new Montchanin station (Saone-et-Loire), in the presence of Francois Mitterrand, it was learned 6 July from informed sources. The exact date has not yet been finalised but a 23 September date was proposed, indicate the same sources. The president of the republic will travel in the TGV from Paris to Montchanin. After this inauguration, other ceremonies will take place in the principal stations served by the new train. The TGV will link Paris to Lyon, Marseille, Switzerland, the Alps and Languedoc in less time than the usual trains, but will only travel at maximum capability (260 km.p.h.) by September 1983, when the St-Florentin (Yonne) Combs-la-Ville (Seine-et-Marne) section of the new Paris-Lyon line will be completed. The journeys at that time will be accomplished notably in 2 hours between Paris and Lyon (3 hours 48 minutes now) and in 4 hours 43 minutes between Paris and Marseille (as against 7 hours and 5 minutes). [Paris AFP SCIENCES in French 9 Jul 81 pp 14-15] 9824

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West Europe Report

SCIENCE AND TECHNOLOGY

No. 76



FOREIGN BROADCAST INFORMATION SERVICE

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WEST EUROPE REPORT SCIENCE AND TECHNOLOGY

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BIOTECHNOLOGY

BRIEFS

GENETIC RESEARCH--"Inmunologia y Genetica Aplicada SA" has been established with headquarters in Barcelona. The firm's purpose is applied research in the field of genetic technology for application in veterinary medicine. Methods developed by the Center for Molecular Biology at the University of Madrid will be converted to practice. Majority participation (51 percent) in Ingenasa is by Initec, the Engineering firm of the government Industrial Holding Authority (INI). The remaining shares (49 percent) are held by "Laboratorios Sobrina SA," Olot/Prov. Gerona, a manufacturer of veterinary medicines. [Text] [Duesseldorf CHEMISCHE INDUSTRIE in German Jul 81 p 396] 9160

CSO: 3102/403

ELECTRONICS

SAAB-SCANIA EUROPEAN LEADER IN CHIP-CARRIER METHOD

Background

Stockholm NY TEKNIK in Swedish 16 Jul 81 p 6

[Article by Ulla Karlsson]

[Text] First in Europe. Saab-Scania was the first to invest in a new technology to reduce the size of and put together the smallest components in electronic equipment: the chip. The method is called chip-carrier and it permits an 80 percent decrease in the surface area of integrated circuits compared with circuits used today. The great breakthrough for the method in the United States is expected next year. So far it has been used mostly for military and space technology.

Integrated circuit technology is being developed constantly to create more compact components and more complex circuits. Along with this comes an increase in the number of input and output terminals. The so-called DIP's, which chips are mounted in today, will also have more leads in the form of small pins. As the number of pins increases, the size of the package also increases. In the end, it is too large to be of practical use.

Completely New Method

Technicians at Saab-Scania's microelectronics division recognized this problem at an early stage. As a result, the company invested in a completely new ceramic packing method--the chip carrier. When this method is used, the size of an installed chip can be reduced considerably.

The volume is reduced by 90 percent and the surface by up to 80 percent.

"The present trend toward more and more compact circuits will also lead to the success of the chip-carrier method," said Hans Danielson, head of the microelectronics division.

Only Possibility

"If a circuit has more than 64 input and output terminals for signals, the chip-carrier is the only practical possibility."

"With the normal DIP a circuit with, for example, 100 pins would be 25 cm long. If a chip-carrier is used, on the other hand, the circuit is only 25 x 25 mm."

"The great breakthrough for this method will probably come in 1982," said Mats Grondahl, chief of marketing for the microelectronics division.

"At that time Texas Instruments will publish results from its work on developing production equipment for the chip-carrier method. The results must be made public since the development work was funded by the American government.

First In Europe

In Europe, Saab-Scania was the first to invest in the chip-carrier. That was in 1978. At that time, technicians at the company were studying how the advanced circuits needed in the Swedish military computer Dator 80 could be produced. They concluded that this was possible only with the chip-carrier.

The result was that Forsvarets Materielverk invested money so that Saab-Scania could begin using this technology. Thus, Saab-Scania became the fourth company in the world to invest in the chip-carrier method.

Withstand High Power

Chips encapsulated by the chip-carrier method are then mounted on a printed board made of a thick film (see separate article).

"Thick-film circuits have many advantages over ordinary integrated circuits," Hans Danielson said. "For example, they can withstand considerably higher power. Our ceramic modules can withstand up to 200 W."

"The heat generated is simply removed by the ceramic material. The ceramic material has a conductivity that is 130 times greater than the epoxy laminate used in ordinary printed circuit boards."

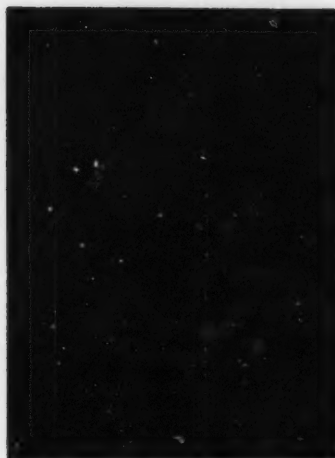
Thick Film Reliable

Thick-film circuits are also considered to be extremely reliable. With this technology, the number of connections on a printed circuit card is reduced, which is important for reliability. It was for this reason, for example, that 2,000 circuits in the space shuttle Columbia were made of thick film.

Saab-Scania is presently one of the European leaders in thick-film technology. With the new chip-carrier method, the company sees a bright future for the microelectronics division.

Sales are expected to increase by an average of 33 percent annually through 1985. Sales in 1981 are expected to reach at least 15 million kronor.

At present, around 15,000 complex thick-film circuits are produced annually. Fifty percent of them are used for the company's own work.



Contacts All Round

Here is how a chip is mounted with the chip-carrier method:

On the bottom is a ceramic plate with a metal pattern on which the chip (circuit) is located. On top of that is laid another ceramic plate with the conductive pattern and external contacts. The contacts are located on all four sides of the circuit (as opposed to only two sides in DIP encapsulation). Before the third and last plate is put on, the chip is affixed--bonded--to the conductive pattern. The upper plate acts as a lid for the circuit. Then the plates are sintered together at 1600-1700°C. The mounted circuit's terminals are soldered (like the DIP capsule's pins) to the tracks of the pattern card.

Thick-Film Technique

Stockholm NY TEKNIK in Swedish 16 Jul 81 p 6

[Text] When a thick-film circuit is to be produced, a graphic model is first made to show how the circuit will be constructed. Today the model is made by computer-aided design--CAD. The result is a photographic background.

The photographic background is used to produce the stencil that is used in printing. The stencil consists of a fine-meshed steel cloth on which certain portions are clogged, while others are permeable to a film paste. The permeable portions of the stencil form the pattern to be printed. Most often a conductive pattern is used, but resistors and capacitors are also made of thick film. The pattern is then printed on a substrate--a thin plate of ceramic material. This is done by pressing the paste through the stencil down onto the substrate. The pattern formed in this way is first dried in a furnace at about 100 to 150°C. It is then burned on (sintered) in a furnace at 850 to 950 degrees. If an additional pattern is desired the procedure is repeated, but with another paste and another stencil. When the substrate

is ready, the active components are attached--they are seldom made of thick film. (Active components are components that process signals in some way, for example amplify them). They are most often integrated circuits.

If the active component is not already encapsulated, the chip is cemented to the substrate. Thereafter, it is connected electrically by attaching gold wire to the chip and to the conductive pattern--the chip is bonded.

When all the components are attached the substrate is encapsulated and the circuit is ready.

Thick film means that the thickness of the paste (film) on the board is about 10 micrometers. On thin film circuits the film is about 0.1 micrometer thick. Thick-film technology is simpler than thin film technology.



Here is the size difference between a chip (circuit) mounted on a so-called DIP (left) and by the chip-carrier method (right). The more terminals required by the circuit, the greater the difference will be.

9336

CSO: 3102/395

ENERGY

STUDIES SHOW SHALE BEST SOURCE OF METHANOL

Stockholm NY TEKNIK in Swedish 25 Jun 81 p 3

[Article by Hans Wener: "Peat and Biomass Are Eliminated; Shale Is Best for Obtaining Methanol"]

[Text] It is evident now that we are going to obtain from 100 to 125 thousand tons of methanol per million tons of Swedish shale. That is definitely cheaper than if it is produced from peat or biomass.

Tests with gas produced from shale for the Inred process are to be carried out in Lulea during February and March 1982.

"We have a very promising research and development program under way at the installations in Ransted," says the director of the ASA (AB Svensk alunskifferutveckling), Owe Carlsson. "We have been gasifying 5 tons of shale per 24 hours in a fluid bed. That method is almost ready for large-scale use and it provides methanol or ammonia as a final product," he says.

Shale from Narke Is the Richest

With shale from Vastergotland as the raw material, the method produces approximately 100,000 tons of methanol per million tons of shale. If one uses shale from Narke, the yield is about 125,000 tons per million tons of shale.

The process produces coke residue which contains approximately 25 percent of the shale's thermal value. How that residue is to be utilized is still to be determined. "It will probably be burned to provide heat for the process and to deliver district heating," Owe Carlsson says.

A competing, or possibly a supplementary, process is the Inred process, which is a process involving the direct reduction of iron ore. Experiments in which one obtains gas from shale for the Inred process are to be carried out in Lulea in February and March. At these higher temperatures, the residues are more glasslike.

The ASA is owned by the LKAB Mining Company and Boliden, which are nationalized enterprises. Last year the company approached the government with a request for

for funds (approximately 100 million kronor) for further development work. The application has been pigeonholed in the Chancellory for the time being, most probably until it has been determined whether one or both of the two methods is good enough to be put into full-scale operation.

Shale Is Best for Obtaining Methanol

"There is no doubt that, by comparison with peat, biomass or residual oil, shale is the best raw material for obtaining methanol," Ove Carlsson believes.

Now 3 years of continued development work in Ranstad are required. Shale from Narke has also been tested there with good results.

In summary, Ove Carlsson says: "A decision to carry out a large-scale operation which makes use of shale should be made in the middle of the 1980's."

The process which is being tested at Ranstad was developed by research carried out under the leadership of Prof Ingem Bjerle at the university of technology in Lund. The research workers concentrated on shale gasification, but not at that location.

Direct gasification of that type was tried out in the field shortly after World War II in Kvarntorp, but without a great deal of success. At that time--during the war--they produced oil from Narke shale. At least enough of it was obtained for the distillation ovens of that time to keep the Swedish submarine fleet going.

Patents to the United State

The nationalized enterprise also owns Svenska skifferolje AB, which operated the Kvarntorp plant. Since 1965, that company has been in the process of being liquidated. According to Director Olle Uddgren, all the remaining work which is to be performed by that plant will be completed during the 1980's.

He says that in 1969 and 1970 the company was reminded by the Ministry of Economy that it was to return the Kvarntorp concession.

The company had collaborated on that concession with two American oil companies in regard to certain patents, on which half of the expenses had been paid by Swedes. Since Swedish interest in shale did not exist (before the shocking increases in the price of oil), those patents were later turned over to the American companies.

Gasification of shale in a fluid bed produces synthesis gas. In addition, tars and gaseous hydrocarbons such as ethers, etc., are formed.

Methanol can be produced from synthesis gas by some type of reforming to get rid of the methane. That is followed by a stage involving the varying of the gas to get the right hydrogen content (proportion of H to CO).

When gasification is accomplished at higher temperatures--as will be considered for the tests with the Inred process next year--the slag melts. One also obtains a better synthesis gas. It becomes pure CO and H.

ENERGY

NEW SOLAR HEAT STORAGE METHOD: BOREHOLES IN BEDROCK

Helsinki HUFVUDSTADSBLADET in Swedish 15 Jul 81 p 9

[Article by Monica Giselson: "An Interesting Project--Boreholes in Bedrock Constitute a New Heat Storage Method"]

[Text] Stockholm (FLT)--The latest technique for storing heat over rather long periods of time consists of boring holes in bedrock, filling the holes with circulating hot water and heating the rock in that manner. Furthermore, it is a technique which makes it possible to make better use of solar heat, above all, but also perhaps of waste heat.

"It is a promising method, both technically and economically," says Sven-Erik Lundin of the Construction Research Council of Sweden. "Storage techniques which have been tried in the past have proved to be tremendously expensive. The borehole method should reduce storage costs by at least a third," he says.

Large Storage Spaces Are the Most Economical

Since industry's interest in solar energy and waste heat has increased, the need to hit upon inexpensive storage possibilities has also increased. To make use of energy as effectively as possible, large storage spaces are required where one can store heat on a seasonal basis, from summer to winter. That is also true of the utilization of the natural solar heat from lakes, bays and inlets.

There are several types of seasonal storage spaces. For example, hot water is stored in large concrete or sheetmetal tanks. Storage spaces in the rock, under-water storage spaces and aquifers are other variants. An aquifer is a natural collection of ground water which can be found in loose types of soil.

"But interest and research are now directed toward storage in bedrock," says Sven-Erik Lundin. "The geological conditions in Sweden are quite suitable for it, and from the economical point of view the borehole method should work out well," he says.

Approximately three-fourths of Sweden's bedrock consists of primary rock, and primary rock is a very good material since it is very solid and has relatively low heat conductivity.

There are several types of borehole storage spaces, but they differ from each other chiefly in the way the interchanging of heat takes place, in how the water is sent down to them and how the heat is recovered.

There are open systems in which the water goes down directly into the rock. Another system has plastic tubes in the borehole, and a third is completely closed, with water which is carried down in U-shaped pipes of the immersion-heater type.

There has been a project called the solar energy project in the Swedish water power department since 1979. In that section, they are also interested in storage techniques.

In August 1981, the various borehole methods will be presented at a working meeting at Vattenfall, and after that there will possibly be full-scale experiments.

Test in Lulea

At the university of technology in Lulea, a test of small-scale boreholes was recently started. Since heat circulates in rock at a certain rate of speed, one also gets a distortion with regard to time when using small-scale boreholes. Thus, 24 days correspond to a year and 4 months are the equivalent of 5 years in the test.

"The power of the storage space we built is roughly equivalent to the annual heating requirements of 25 individual houses," says Bo Nordell, who is in charge of the project.

"Theoretically, a small-scale test should be exactly correct in its functioning.

"The storage space used in the test is 21 meters deep and has 19 holes. The diameter of the whole thing is approximately 5 or 6 meters.

"Borehole storage spaces have other advantages," says Bo Nordell. "They do not take up as much space, are easy to locate and are also easy to enlarge, and furthermore the cost of constructing them is comparatively low."

9266

CSO: 3102/384

ENERGY

GOVERNMENT PLANS NATIONWIDE DEVELOPMENT OF DISTRICT HEATING

Duesseldorf VCI-NACHRICHTEN in German 17 Jul 81 p 8

[Text] District heat is one method of utilizing energy efficiently. Electrical energy and district heat together can take over a sizeable portion of the heating market in the next one to two decades and effect a noticeable rollback in light heating oil.

In spite of the necessity for conservation, according to Minister of Research Andreas van Buelow, the necessary funds must be found to push ahead with a major expansion of district heating and thereby to come closer to the goal of the "Away from Oil" policy. On 6 July, at the presentation of a preliminary study for a Ruhr area district heating design, Buelow announced that he would press the government to stress the expansion of district heating much more vigorously than before in the third updated review of the energy program.

In this context the minister also advocated investing more money for district heat in the review of the DM 4.35 billion energy conservation program. Thought should be given to government assistance to tie houses into district heat networks, which were not supported previously. According to his figures, district heat has so far only an 8-percent share of the heating market in the FRG. With a realistic design for expansion, up to 25 million standard coal unit tons in oil could be saved annually.

In the Ruhr, the largest area of industrial concentration in Europe, the "Community Association of the Ruhr Area" (KVR) thinks district heat expansion could be carried out in the next 12 years. As KVR director Juergen Gramke explained, the study, which has not been presented, shows the area ways to realize a safe, nonpolluting and economical supply of heat. A four-phase plan proposes overall regional planning, with particular consideration given to expansion of district heating. In order to agree on initial concrete planning steps, it suggests that all the companies active in the district heating market sit down soon at one table for a "Ruhr Area District Heating Conference."

Efficient use of energy means basically the replacement of energy through capital and/or investment, while making full and intelligent use of energy. The plants for heat distribution in particular are highly capital intensive in the area of providing district heating. So the use of district heating is limited to correspondingly concentrated areas. On the other hand, district heating meets the demands of an

energy policy for energy conservation, the use of coal and later nuclear energy, relieving the balance of payments and an improvement in environmental conditions in the cities. Compared with other methods of efficient energy use, district heating from heat generating stations in areas suitable for them shows the most favorable cost/benefit ratio of all.

In 1980 district heat achieved a hookup growth figure across the FRG of about 110 Megajoules/second (Megawatts, thermal). This is the equivalent of a heat requirement of about 150,000 WE (WE: a standard living unit of 70 ms²). So district heat is meeting about 8 percent of the demand for heating and hot water. About 70 percent of this heat comes from energy-conserving heat generating stations.

As is known, the short- and long-term possibilities of district heating from heat generating stations were studied in detail from 1974 to 1977. It turned out that district heat can be tripled or quadrupled in the long term--but the problem of startup losses must not be overlooked.

Heat generating stations of different sizes should be located as close as possible to the consumer. If nuclear power plants as well are to be used later for city district heating, the distance from the areas to be supplied must be considered in adequate time.

The emissions-reducing effect of district heating is higher by far than the additional emissions from central heat generating stations with high smokestacks and suitable exhaust purifying installations. However, federal emissions protection legislation does not yet take this into account.

The construction and expansion of district heat systems presupposes corresponding planning by the companies. Under local designs for supply, medium- and long-term possibilities for district heating are to be worked out and put into practice as financing permits.

Financial incentives for the supplier companies to partially cover the startup losses and for the users to switch to district heat can substantially speed up the development of district heat regions. In addition, larger supplier areas can be steadily covered in this way.

The main emphasis in the future development of district heat will at first be on the cities which are already accessible to district heat. (Fifty-seven cities in the FRG already have heat generating stations.) The most cost-effective heat can be tapped off from electricity generating stations which have to be built anyway for reasons of economy. With a sufficient potential size and justifiable distances for transportation, nuclear power plants can also be brought in for district heating. There are clear political implications from this fact for the location of nuclear power plants.

In addition to tapping off heat from heat generating stations, the use of industrial thermal effluent is also important. In each individual case there must be an examination of the peripheral conditions under which a contribution to public district heating is possible.

The maximum distance for the transportation of district heat depends on several parameters--basically on the total output of the supplier area. The distance has grown further because of the rise in primary energy prices. Nevertheless, the emphasis in the continued expansion of district heat lies in the construction of local networks, which can later be developed into regional lines of supply.

Investments in the area of district heat, which were still about DM 350 million annually in 1976/77, have grown to about DM 1 billion annually in 1980. With additional measures for assistance, this volume of investment can certainly be doubled in a few years, but not trebled.

In spite of its clear advantages for energy economics and the national economy, district heating has to be attractive from the consumer's point of view. So the precondition for an accelerated movement to hook up to district heat is not administrative compulsion but suitable products on the market from the supplier companies.

9581

CSO: 3102/400

ENERGY

BRIEFS

WIND-POWER RESEARCH CONTINUES--The wind-power plant installed at Ouessant by Electricite de France (EDF), and which was supposed to generate 1000kW, failed in July 1980 after only a few hours of operation: one of its blades broke, destroying the installation within a few seconds. However, efforts to tame the energy of the wind have not been abandoned. The repaired Ouessant plant has been undergoing tests since last February near Bordeaux. EDF would like to test it for 6000 hours before deciding whether to rebuild it. In reality, such wind-power plants can operate without risks only with very reliable blades, such as are used in helicopters. A large contract is underway to ask such specialized companies as Aerospatiale to study the problem; these helicopter-type blades cost twice as much, causing the builders to hesitate. There are plans to install in Bretagne--probably at Lannion--a scientific test center for wind-power plants, which would be supported by the Scientific and Technical Center for Building in Nantes. The aim of the center would be to establish standards for these plants, so as to enable the launching into production of well known equipment, whose qualities could be easily verified.

[Text] [Paris LE MATIN in French 19 Aug 81 p 32] 11,023

CSO: 3102/411

ROBOTS WITH SENSE OF TOUCH BEING DEVELOPED

Duesseldorf VDI-NACHRICHTEN in German 26 Jun 81 p 9

[Article: "Feeler Provides Sense of Touch for Robot"]

[Text] A branch of the German Aeronautics and Space Research and Test Agency, the Institute for Dynamics of Flight Systems in Oberpfaffenhofen, has been conducting research and development for several years on computer controlled robots with tactile feedback since the sense of touch is just as important as vision for many tasks. The objective of this work is to replace the human being with computer controlled robots in hard-to-reach or dangerous places, for example in space or at great ocean depths.

Previous effort was concentrated on programming computer controlled robots in the work room with a master computer which converted the objective cartesian coordinates into appropriate member angles and transmitted them to the robot's computer for execution. An additional focal point of this work was the testing of a 3-dimensional strain-gage force and moment feeler developed at the Institute for Dynamics of Flight Systems to provide the robot with a sense of touch.

The sensor consists of a base ring connected to a coplanar hub by 4 spokes. The hub is connected to a second ring by 4 columns. If forces and moments are introduced between the upper and lower rings, they produce, depending on direction, small mechanical deformations (compression or extension) in 2 or more spokes or columns. Eight pairs of tension strain gages (DMS) are bonded on in an array such that the change in resistance is a measure of the sensor's loading. The resulting electrical signals have to be amplified before they are fed into a matrix for computing the 3 forces and moments. The individual elements of the displacement matrix result from the mechanical properties of the sensor, loads are always applied in the same sequence so that instrumentation or loading errors can be detected immediately. Each sensor has its own individual matrix which is stored and which does not vary through time so long as the sensor is not mechanically overloaded; and this is prevented by strategically located stops. Sensors can be designed for a wide range of loads by simply selecting different dimensions for the components. Existing designs cover the load ranges 0.1 to 10 kp and 1 to 200 kp.

To date, the main problems which have been jointly studies with industry relate to assembly and joining processes (for example, the assembly of an oil pump) and grinding problems (cleaving of castings). This work showed that the sensor developed by the DFVLR is suitable for a variety of tasks, contrary to the widely held notion that a special sensor would be required for each new application. In addition the accumulated experience clearly shows that future robot generations can be made much more efficient by incorporating tactile sensors.

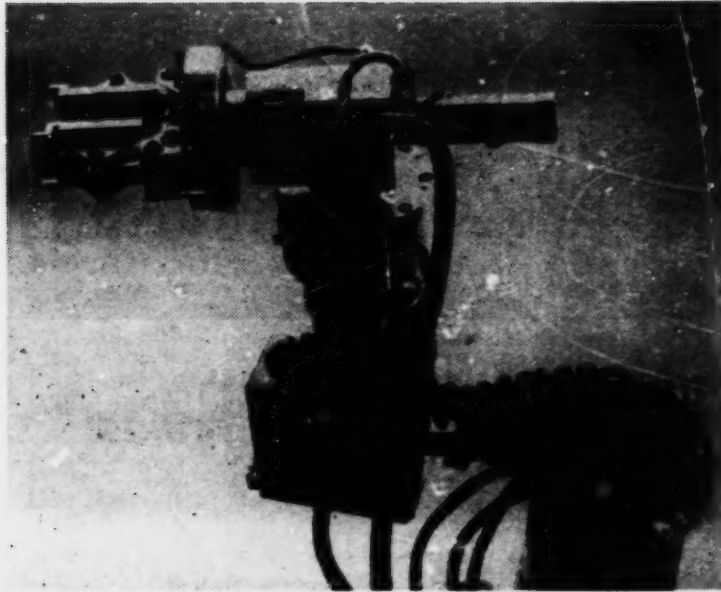


Figure Caption:

A 3 dimensional force and moment feeler is able to provide tactile sense for a computer controlled manipulator. It employs 8 pairs of strain gages.

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CSO: 3102/394

RENAULT'S USE OF ROBOTS EXTENSIVE AT FLINS PLANT

Duesseldorf HANDELSBLATT in German 1 Sep 81 p 16

[Text] Frequent model changes in auto building leave the manufacturers no alternative to installing manufacturing equipment which can be converted quickly and cheaply at model changeover. The French Renault combine seeks its salvation in its own robots.

In the Renault factory at Flins, a robot paints the inside of an R 5 chassis as deftly as an elephant blowing water out of its snout. The agile device owes its dexterity to the fertile imagination of the French designers who--so it seems--draw their ideas from the animal kingdom. Like a snake, the robot's arm can flex in any direction. This capability is matter-of-factly referred to by the Renault engineers as "mobility in 7 axes", a feature lacking thus far in American and Japanese manipulators.

The chronic inclination of French engineers to want to attack a task differently than their colleagues in other countries has led to the development of a whole family of original robots at Renault. Also standing behind their do-it-yourself design is the Gallic compulsion to want not to become an American colony. On the other side of the Atlantic, the innovative activities of the French automobile builders are obviously being watched closely since, in October 1980, Renault formed a joint venture with the Ransburg Corporation--American specialists in surface coatings located in Indianapolis--for the development, manufacturing and distribution of painting robots (Ransburg 51 percent, Renault Industrial Equipment Engineering 49 percent).

Today, in the Flins factory 72 percent of the nearly 4500 weld points on the R-18 automobile are made without human hands. Automatic welding machines tailored for the particular type of auto are the main contributors to this high degree of automation, of course. Renault makes about 10 percent of the welds on the R 18 with robots. The robots which have been installed stepwise in the Flins factory since 1978 should demonstrate how they will prove out in the rough assembly-line environment. They are in operation for 15.5 hours per day. Pierre Pardot, director of automation engineering, lists the availability of his 30 mechanical slaves at 99 percent; 99.5 percent is targeted.

If the application of robots in the production of the R 18 can still be regarded as a prototype operation, this will not be the case in the new Douai factory. In manufacturing the "142", today's name for this factory's future product, the degree of mechanization will be increased to 95 or 96 percent; and this time robots will take over most of the work.

The production engineers will naturally incorporate in the new factory the clever details tested at Flins. For example, automatically-read markings on the stepwise-evolving chassis tell the robots what programs are required for the next manufacturing step. The ability to vary the tasks of these untiring mechanical helpers by

program selection solves not only technical problems but also creates extraordinary flexibility in vehicle output. If more autos per day are required from the assembly line, then the robots--they also have their limits--simply weld fewer points per chassis. What is left undone will be done by hand by human workers. In this manner, production variation of up to 50 percent can be accommodated.

It is no longer possible for man to do all the jobs a robot can do. For instance, an "iron welder" holds a spot-welding gripper weighing up to 80 kg. With no effort, the robot can reach this heavy gripper around the door frame and make a weld on the floor plate in the center of the vehicle. A gripper opening of 60 to 70 cm obviates expensive, highly mechanized tools which cannot be readily reworked at model change-over. So that a robot with such a heavy gripper does not spend too much time opening and closing its gripper, Renault engineers have chosen an 8-step variation in this additional controlled "axis." Part of the required gripper adjustment is made as the robot moves the welding gripper from point to point, and the final adjustment is made at the terminal point.

Having in-house capability for manufacturing machine tools made it easy for Renault to decide to build its own robots. Today, the robot development team numbers 130 people, 70 percent of whom are university graduates. Pardot points with pride to the high know-how of his troops. An example of their capability is a prototype of a seeing robot which can pick up the topmost of a pile of drive shafts. However, Renault's production robots come from Acma-Criebier in Beauchamp. This subsidiary of the auto concern has 350 employees and logged sales of FF 150 million in 1980, 60 percent of which was in robots. To date, 220 units have been delivered with 60 percent staying at Renault. Acma is consciously aiming at diversification into non-auto industries. The robot program extends from electrically powered devices with an 8 kg payload (DM 130,000) up to hydraulically powered versions with a payload of 80 kg (DM 220,000 to 240,000). Depending on the application, the robots operate from an overhead frame, a pedestal or a vertical column, like an ape in a tree.

9160
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INDUSTRIAL TECHNOLOGY

FRENCH MACHINE TOOL INDUSTRY TO BE RESTRUCTURED

Paris ELECTRONIQUE ACTUALITES in French 4 Sep 81 pp 1,3

[Article by G. Bidal]

[Text] During the summer, the government tackled the difficult topic of the machine-tool industry (MO), and at least indirectly, the electronics industry is concerned by the technologic changes which will be the true stakes of a restructuring which everyone deems inevitable. Indeed, automation appears to be the only chance for the survival of the French MO. At least one of the various poles of this restructuring should be organized around the idea of flexible shops, whether by user sector (automobile construction, for instance) or by product (machining centers in particular).

France wants to pick up the challenge of industrial automation. The statements of the prime minister as well as those of the ministers of industry and research have been clear in this respect. And one of the six think-tank sector-commissions being instituted by Mr Dreyfus will be devoted to robotics.

Although the present circumstances appear to be less gloomy in the automation industry than in other sectors of electronics--particularly in the wake of several gratifying export contracts: subway and train in Egypt and Brazil, electrical equipment in Venezuela and South Africa--the major problem is MO. This sector, which has had a turnover of 2.5 billion in 1979, is sick: it lost 7000 jobs (it currently employs 19,000 people) and one-quarter of its production in five years. The low investment in this very scattered sector (three-quarters of the 180 French MO businesses are small and medium-size enterprises) has not allowed it to undergo indispensable changes, beginning with a symbiosis with electronics which has made Japan's success.

Let us make no mistake, the electronics world cannot remain indifferent to the drifting of the French MO. First of all because several electronics companies have an interest in it (such as CIT-Alcatel with its Graffenstaden subsidiary, Sagen, or Matra with Manhurin), but also and mainly because a strong French automation industry cannot be imagined without the support of a lively MO sector. As an example, the French builders of light-weight robotics (Afma, Climax, Sormel),

although unquestionably well positioned in Europe and even in the world, have had their impetus stemmed by the absence of investments from MO, whereas one of the keys to Japan's success has in fact been the offer of machines already equipped with loading arms.

Today, everyone agrees that the main chance for survival of the French MO is in top of the line machines for flexible shops.

The Line Case

The refloating of Line, the second largest in the French MO, in the form of a financial support of 360 million francs (in equal parts from banks and the authorities), has been only a stopgap measure. At the request of the President, the complete MO file is in the hands of Mr Dreyfus, minister of industry. Four think-tank groups have been instituted, one on special and heavy machinery, another on catalog machines, a third on research (automation), and the last on trade policy.

Several restructuring plans are being considered: by products, with heavy machines on one hand around a Line-TMI-Forest pole, and machining centers-flexible shops (around Renault MO); or by sectors of activity, with aircraft builders (Berthiez, TMI, Jordan) and the automotive industry (again around Renault). The question still remains whether restructuring will occur within the MO sector or whether connections will be made with outside enterprises. The automotive industry is a favorite, but electronics should have something to say in all this.

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TRANSPORTATION

AUDI PROTOTYPE MAKES WIDE USE OF LIGHT METALS, COMPOSITES

Turin ATA in Italian May 81 pp 316-320

[Article: "Audi Quartz Pininfarina"]

[Text] The "Quartz" comes within the framework of the programmed research that Pininfarina has set for itself for some years now in order to cope with the subjects connected with the evolution of the automobile.

Many factors have influenced and continue to influence the technical and stylistic conception of the automobile, but the energy aspect has prime importance today. Decrease in fuel consumption depends not only on the characteristics of the mechanical organs but also on the design of the body, and in this sector, Pininfarina has made and will continue to make its contribution. The new generations of bodies will have to be more aerodynamic and lighter.

The aerodynamic aspects are part of the study for an ideal form carried out a few years ago on behalf of the CNR (National Research Council).

The considerations connected with a "light" vehicle that achieves the best ratio between weight and power have now been tackled with the "Quartz," through an original body study carried out with new materials that current technology is already making available or that will be available in the near future, coupled with a basic mechanical design that proposes pioneering approaches that are relatively simple and light for a four-wheel-drive car.

A year ago, at the Geneva Salon, Audi presented a new item of special interest: the Audi 4, a four-wheel-drive sport coupe specifically designed for rally competition.

The four-wheel-drive system in the Audi 4 has been built by relatively simple and light technical solutions that Pininfarina considered particularly suitable for the body-design base that it had in mind to construct.

For this design, Pininfarina made use of a whole series of new light materials carefully selected from among those produced by the most advanced technologies used in the aeronautical sector in particular.

The originality of the design lies also in its transferring these materials from the aeronautical to the automobile sector--not only to competition cars only, though, but also to mass-production autos.

Study of the application of light materials in the automobile industry has currently become basic, because of the importance of vehicle weight for fuel consumption.

In the United States, for example, 1985 has been set as the date by which automobile fuel consumption must reach an average of about 11.7 km per liter.

Therefore the weight-to-power ratio--an index of the sport performance characteristics of a car--must today be considered also as a fuel-economy factor.

The relation between fuel consumption and weight depends on the way in which the so-called "light" solutions are introduced: it is not a matter only of replacing materials with others that are less heavy, but also of going in the direction of different design philosophies, suited to the new materials.

We will have an initial phase in which the gradual replacement of the normally used materials will lead to hybrid bodies--composed, that is, of elements of different kinds.

This prototype is intended as a practical example of the use of light materials, metallic and nonmetallic.

The concept inspiring the body line was to obtain a dimensionally compact form--therefore one that is light, of simple design, but strongly characterized.

The result is a body that has a "groove" around its perimeter, ideally dividing the upper part from the lower.

With this "groove" is also associated the function of conduit for the internal aerodynamics of the engine compartment: air enters in the front through the slit in the forward part of the "groove" and is discharged in the zone immediately behind the front wheel wells.

Another characteristic of the car is the total absence of protrusions: the windows have no external posts; the door handles are concealed behind door windows; the front and rear lights are recessed into the body form.

In line with the approach taken, the dimensions of the optical units are minimized.

The headlights, the result of a study by Carello, use elliptical optics and are greatly reduced in their frontal dimensions, while achieving performance characteristics that are entirely comparable, if not superior, to those of the most powerful traditional headlights. Their lenticular appearance and their placement characterize the front part of the car.

For reasons of compactness, the rear has minimal bulk, yet sufficient to provide a sizable luggage compartment for this kind of car.

Other characteristic elements are the external rear-view mirrors, which also provide for dynamic ventilation of the interior. When automobiles were fitted with wing windows, internal aeration was provided for by the fact of their mobility. Today the movable wing window has disappeared, mainly because of the regulations about visibility, and the new rear-view mirror patented by the SAIAG [expansion unknown]

performs the same service in a modern fashion. The wind-tunnel tests run have confirmed its validity.

Used air is exhausted from the interior through a slit formed by the special design of the rear side window. The car's interior has been designed in the spirit of the approach taken, using light materials and coverings in a design characterized by maximum simplicity and functionality.

A rail of section similar to that of a handrail runs laterally along the doors and the rear sides and functions as armrest, support grip, housing for controls. In the front, this rail develops in such a way as to become the dashboard.

The characteristic feature of this dashboard is the absence of protrusions: the instrumentation is recessed and covered by a special screen, transparent from certain angles and opaque from others, so that it provides maximum legibility of the instruments from the driver's seat and eliminates annoying reflections of the instruments on the windshield.

The glove-compartment door holds the on-board computer, and with the door open, presents it in such a way that it can be used like a keyboard.

The on-board service functions include also a secondary instrumentation comprising two lights indicating locking of the differentials--the control is located on the central console--and four lights to signal insufficient tire pressure.

The passenger arrangement is that of a 2 + 2, with good leg room for the rear passengers. The fuel tank, of an original T shape, is under the floor and between the rear seats, and its capacity is about 85 liters.

This approach, in addition to providing a safe position, gives a geometrically very usable floor area, with a useful volume of about 300 liters. With the backs of the rear seats capable of being lowered flat separately, the load volume becomes about 800 liters.

Light Materials Used

The composition of the prototype is as follows:

Outside:

- front and rear bumpers of Kevlar-honeycomb-Kevlar sandwich structure;
- hood, roof panel and side panels of aluminum;
- door panels of steel-polypropylene-steel sandwich laminate;
- rear window of polycarbonate;
- rear-window frame of carbon fiber.

Inside:

- seat frames and steering wheel of carbon fiber;
- upholstery covering of parachute cloth.

Aramid Fibers - Kevlar

For about a decade, this particular aramid fiber has been used in a very wide range of industrial applications, and more recently it has been used in sports cars in order to obtain very light bodies. It has very low volumic mass (1.45 g/cm^3) and high tensile strength ($3,617 \text{ N/mm}^2$).

The principal characteristics of Kevlar can be summarized as follows:

- the highest strength-to-volumic mass ratio of all fibers;
- rigidity-to-volumic mass ratio lower than graphite only;
- excellent intrinsic strength;
- good thermal stability and resistance;
- good resistance to chemical and atmospheric resistance;
- high vibration-damping capacity: 8 times higher than steel and 4 times higher than that of the other reinforced fibers.

On the prototype, Kevlar has been used in the construction of the front and rear bumpers, and in particular, as the outer surfaces of a sandwich with honeycomb panels inbetween.

The whole is characterized by very limited weight and high compression strength; the bumpers are therefore capable of sustaining strong impacts without deformation.

Honeycomb

This particular configuration, whether of aluminum or of aromatic-polyamidic paper, is widely used in the aeronautic and aerospace industry, since it makes it possible to obtain sandwich-panels with the following characteristics:

- very high strength-to-weight ratio;
- very high rigidity-to-weight ratio;
- high compression strength;
- high fatigue limit;
- good heat resistance and good heat-range tolerances;
- acoustical-absorption properties;
- high ratio of exposed surface to volume occupied.

Depending on the type of cellular configuration, it is possible to make the material take special curves and bends, such as spherical caps, flexes, cylindrical surfaces.

Indeed, the core of the bumpers is obtained by shaping honeycomb panels of negligible weight to the bumper cross-section.

Carbon Fibers

Carbon fibers, in the form of fabrics or as elements obtained by poltrusion, are gradually arousing growing interest in the automobile field. The explanation is

simply that with equal mechanical strength, it is possible to achieve weight savings on the order of about 70 percent as compared with steel and about 33 percent as compared with aluminum.

The characteristics of:

- low volumic mass (1.75 g/cm^3);
- high rigidity;
- resistance to corrosion;
- fatigue-stress resistance;
- thermal stability;
- low electrical conductivity;
- low X-ray absorption;

make possible a wide range of applications on automobiles--mechanical elements such as drive shafts, engine mounts, springs--or body elements such as internal bracing, bumpers, door panels, hoods, etc.

The prototype offers, as examples of possible applications, the rear-window frame, the seat frames and the steering wheel, made of fabric of carbon fiber stratified with epoxy resin.

Metal-Plastic Laminates

An innovation in the field of light metallic materials is represented by the metal-plastic laminates, in which two thin laminas of steel or aluminum are joined to a polymer core, with the whole forming a structure whose properties are comparable to integral steel or aluminum.

The product in question makes it possible to reduce weight by about 50 percent as compared with an equivalent structural element of sheet steel; therefore, especially as regards their cost of purchase and use, the metal-plastic laminates are valid substitutes for sheet steel. Moreover, the thermal and acoustical insulation characteristics offer considerable secondary benefits in automobile-building.

The forming of this type of material requires bending machines and presses of lower power for the same thickness; therefore it is to be noted that substitution for a standard sheet, in terms of strength, is obtained with a total sandwich thickness greater than that of the reference sheets.

In any case, the quantity of steel used, by weight, is still less.

A very important role is therefore played by the plastic core, and the performance characteristics of the laminate depend on it. It has been observed that nylon cores seem to offer better characteristics of bending strength, resistance to denting, recovery of elasticity, impact resistance, especially if joined with aluminum.

From the point of view of body assembly, a "disadvantage" of the metal-plastic laminates--though one that can easily be overcome--is the impossibility of making welded joints. For now, riveting, calking or bolted elements have to be used.



This last-named approach has already been used for rear fenders for some time, while the joints of the preceding types are normally used for doors and hoods.

In line with this, the prototype's doors have been made of steel-polypropylene laminate, demonstrating its drawing characteristics with the special section of the car's side.

The thickness of the laminate used is 1 mm, formed of two steel laminas of 0.2 mm and a 0.6-mm polypropylene core--that is, a laminate 60-percent plastic.

Aluminum

Aluminum is the metal material with the lowest volumic mass (2.7 g/cm^3), and it has always been widely used for purposes of lightness: in aeronautical construction and for automobiles, it has no rival among metal materials.

The aluminum alloys are of various types, depending on the percentage of the added elements, such as copper, silicon, magnesium and zinc.



In this way, alloys are obtained with particular use characteristics.

For the engine hood, the roof and the side panels, the "6000"-series alloy was used, the characteristics of which can be summarized as follows:

- good drawing quality;
- fair weldability;
- optimal corrosion resistance;
- yield-point and maximum tensile-stress values comparable to those of steel.

Polycarbonate

In the prototype, the rear window has been made of polycarbonate, as an example of substitution for glass.

In this way a weight-saving that can be estimated at about 50 percent is possible, as is shown by the following table:

Thickness (mm)	Polycarbonate: kg/m ²	Glass: kg/m ²
4	4.8	9.6
5	6.0	12.0
6	7.2	14.4

In addition to this there are characteristics such as:

- good mechanical strength within a wide range of temperatures and physical conditions;
- thermal-expansion coefficient better than that of glass;
- heat insulation higher than glass;

- excellent transmission of light;
- excellent filtration of infrared rays and especially of ultraviolet rays;
- excellent resistance to chemical agents;
- good deadening of sound;
- good abrasion resistance;
- low volumic mass (1.2 g/cm³).

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TRANSPORTATION

DEVELOPMENT OF AUTOMATION IN BODY MANUFACTURING AT FIAT

Paris INGENIEURS DE L'AUTOMOBILE in English Jun-Jul 81 pp 48-52

[Article by M. W. Vignale, director of manufacturing, Fiat factory, Cassino]

[Text]

In the broad field of automation, and more particularly in the field of flexible automation, the subjects described in this presentation regard some of the most significant technological implementations made hitherto at Fiat Auto.

They regard body manufacturing operations, i.e. that portion of automobile manufacturing which has originated probably the toughest problems for the Company, both for the concentration of actions by the Unions, and for the immediate interaction with market phenomena.

In our body manufacturing, if we look at things in chronological order, we can by and large say that automation has evolved through the following steps:

- before 1968 the main objective was to eliminate with automation those human jobs that were either dangerous or unhealthy, taking advantage from the opportunities offered by a constantly rising production and the foresight of payoff through scale economies;
- between '68 and '73 the technological effort pursued, by taking into consideration the claims evidenced by the contestation, but meanwhile also to succeed in producing not withstanding the persisting conflictuality.

From '73 till now, in order to cope with conditions of market saturation featuring uncertainty of time continuance and abrupt jumps in quantity and mix of the demand, our Company has introduced those technological innovations which could contribute

to recover some margins of flexibility that had been lost as an effect of the contestation.

Today, after breaking into the Eighties, the model of a rigid production line delivering identical products throughout several years is being gradually substituted by a model of marked flexibility, according to which every productive unit (for instance every shop) can deliver diversified elements to different productive units downhill, according to schedules of quantities and mixes that can vary between ample limits.

Besides this, there is a trend to conceive and implement production toolings that can be more easily modified for future car models.

In other words, flexibility has two aspects; one is the capacity to produce at any time more models in variable ratios, the other is the capacity to convert the tooling (rapidly and with moderate expenses) in the event of models changeover.

The body and assembly operations can be subdivided into three main areas each one characterized by peculiar type of work and environment: the body-in-white, the painting, and the final assembly.

Let us now go into some detail within the body-in-white area.

Until 1960-1965, all over the world the welding, which is the prevailing activity in automobile body-in-white fabrication, used to be executed by hand.

The parts to be joined were clamped on captive fixtures, fixed on the shop floor or moving along a line depending on the required hourly production and consequently on the degree of job partition among the workers.

The major assemblies composing the body were then welded together in a bigger fixture with three dimensional extension called the Main Assembly Jig.

Mechanization and conveyor transport were used for handling the heavier or the bigger stampings or subassemblies, but all of the welding spots were applied manually, with considerable worker's effort in handling the heavy suspended gun, however counterbalanced it could be to ease the vertical displacements.

The environment was all but comfortable, the aerial conveyors and the suspended transformers with their cables and cooling pipings prevented the natural light from arriving at the working posts, the noise level was high due to the impacts of steel parts on their supports, to the intermittences of opening and closing of air-operated guns and the continuous movement of conveyor chains.

In 1961, on the occasion of tooling up for the new model car 1300/1500, Fiat automated the welding of the biggest subassembly composing the body, i.e. the body floor and trunk floor, complete with the side sills, the cross members for stiffening and the attachments for the power train and suspensions.

This is a machine built on the principle of the mechanical transfer lines, a certain number of multiple welding stations between one loading and one unloading station, mechanized transport between stations, mechanized workpiece clamping in each station.

The human task here consists of positioning the loose parts on the loading station, welding becomes the machine's task.

The need for qualified labour to do the maintenance is increased.

The machine improves the quality and the consistency, at least for this most important assembly group.

The rigidity was the main drawback of such type of machine, as it was very soon experienced.

Nevertheless, the constructive concepts of the first transfer welder are extended and

applied for the subsequent toolings dedicated to models 124, 128 and 127.

Not only the floor, but the entire underbody, the unisides, the roof, the doors and hoods, are all assembled on multiple spot transfer welders.

The worker is so liberated from a good deal of the welding that comes prior to forming the body as a three-dimensional closed shell. But the inconvenience of rigidity is enhanced: the welding machines are dedicated, each one being tied to a specific model of car, any design change made on the body requires long production holdups for machine modification, and at the end of a model's life hardly anything, more likely nothing at all can be saved for further use.

The Major Assembly Jig remains the traditional one, with four or five workers loading the component assemblies and clamping them in the correct relative position, then tackwelding manually one to another.

The technological situation described applies to the end of the sixties, while the more lively labor moves, among many items, raise those of work organization, of monotony, of the environment.

In 1972, for the brand new Cassino Plant, new tooling is conceived and built for model 126.

Mechanization in the body-in-white area extends itself to the Major Assembly Jig, which is now made to effect not just the tacking, but nearly the complete body welding.

Thus a twofold target is reached, to save the worker one more arduous stage and to improve the consistency of geometry from one body to another this being a prerequisite to obtain those close tolerances which will be necessary for a correct application of robots for weld completion after tacking.

The Automatic Assembly Jig for the 126 has its defects too, it is a congested and complex machine, too many transformers and electrodes are concentrated in its two stations, maintenance will originate problems due to the slowness of every intervention, which involves downtime for the entire line.

More and more is felt the need for in-process buffer storages.

In 1972, at the same time when the 126 Automatic Major Jig is adopted at Cassino, in the Mirafiori Plant the first large scale application of robots starts its operation. The installation includes 16 robots,

and the task is the completion welding of bodies after their tack-welding on a traditional manual Major Assembly Jig.

The evolution continues and brings in 1974 to the tooling for Model 131, which is duplicated at Mirafiori and Cassino with some minor differences suggested by the different production requirements.

This is an important milestone not only for the type of machinery, but also for the layout, and has remarkable effects on work organization.

Wider spaces surround the machines, the lighting is improved, the ambient noise level reduced.

The Major Assembly Jig is split into two stations, and there is already a beginning of flexibility, at Mirafiori for the 4 doors body and the two doors in casual sequence, at Cassino for the four door and the Station Wagon.

The robots are applied with no more doubts about their efficiency, which has already been proven by two years of excellent performance on the 132 Model.

The system of conveyance of the bodies through the Major Assembly Jig and the robots contains a substantial innovation for the quality and the uniformity of the product: the pallets.

Each body is clamped underneath at the beginning, and is kept clamped throughout the completion of welds, in stead of being clamped and unclamped at each station. This avoids the distortions otherwise induced by the coaction state into the partially welded bodies.

1978. The experience acquired on welding robots, on pallets for the entire body, and on process computers have made the time mature for implementing a body-in-white installation of entirely new concept to which the name Robogate is applied. Such installations have been set up in the two plants of Rivalta and Cassino for the Ritmo model car.

Let's for the moment synthesize the main features, to begin with the name Robogate which is motivated by the fact that the welding operations are done by robots and that in the tack-welding stations the geometry of parts positioning is assured by fixtures having the shape of « Gates ».

Material handling is effected by means of self moving carts called Robocarriers.

The system can assemble more variants of the same model body or even different body models.

A detailed description of the Robogate system operation will be given later, after a hint to a further development in the chronological order.

In 1979, on the occasion of the tooling for the Panda model, a robotized Major Assembly Jig is installed at the Termini Imerese Plant.

In such installation, the tack-welding operations on the car body are made along a palletized transfer line. Such solution, although offering a lower degree of flexibility than the one obtainable from a transport system based on Robocarriers (as in the Robogate) permits to reduce the total area and the cost substantially.

The body arrives at the Major Assembly Jig with only toy-tabs bent to hold together its main assemblies, and is deposited on a pallet.

The step by step transfer mechanism carries the pallet into the tack-welding station; here clamping devices by forcing the toy-tabs, give the fine location in space of the above said assemblies, after which the tack welding takes place.

The station structure is composed of supports for:

- the vertical robots;
- two swinging gates equipped with clamps for one model body;
- a second pair of gates equipped with clamps for another model, which if necessary can be completely different from the first.

The change of gates is done by quick - shifting them forth or back alongside the direction of the line, the shifting occurring, if required, during the time the next body is carried into the station.

This system can therefore weld different models of bodies, presenting themselves in random sequence at the tack-welding station. If the different models require different pallets, it will be necessary to install by side of the line a pallet warehouse with which the line can interchange pallets; each interchanging operation will have to occur within the cycle time of the line.

In the stations following tack-welding, completion welding and chassis number engraving are carried out. The operations

foreseen by the system start with one loading station and ends with one unloading station. The system is integrated with a buffer storage of welded bodies, which permits to continue production in the event of a line stoppage.

The system of Termini Imerese was adopted because of the following advantages :

- production flexibility;
- improved working environment;
- limited production losses.

ROBOGATE

As already mentioned, the name Robogate has been given to a specific type of system, which operates in the body-in-white shop, and has been used till now for the body assembly of the Ritmo car in the 3-door and 5-door versions and for the fabrication of the uniside subassemblies for the same model car.

The most important novelty of the Robogate is this : unlike the system previously adopted, it has a great flexibility (in itself it would have even complete flexibility, which on the other hand would be prevented by other areas of manufacturing). In fact the Robogate is capable of handling at any time two different model cars at fixed total hourly output and variable partition between zero of the first model and zero of the second model.

Moreover, the Robogate will require only a partial adaptation to allow for new models to be produced.

Flexibility therefore means also that the system (in the majority of its structure) is going to have a longer life than the models that it produces.

This is important if we bear in mind that today, in all countries, the body styles tend to evolve more rapidly than in the past.

One of the objectives that have been pursued in creating the Robogate has been the implementation of a welding system that does not have to be dismantled when a model is changed, but only adapted in some of its parts, thereby requiring reasonably short changeover time and limited expenditure.

From the viewpoint of the product, two distinguished Robogate system have been designed, although both rest on the same

general operating principles : a Robogate for uniside subassemblies welding and Robogate for body assembly welding.

Let's now consider the fundamental components of the general Robogate module, and describe the machines and their purpose.

The welding spots, as said before, are applied by robots, and these are organized in groups, each group containing a minimum of two and a maximum of 5 robots.

A group includes all the robots that do their job at the same time on the same body.

Each group defines one welding station and the appearance of it can be described as a porch with upright pillars topped by horizontal beams with overhang, forming altogether a parallelepiped having its three dimensions about three times those of a car body.

Every robot presently has in its memory the two work programs which have to be executed, depending whether the station becomes occupied by the 3 or 5 door version of body (or uniside).

A Robogate module is composed of several stations. Each station can be compared to a work island, because each station is allowed to work at a pace which is not necessarily synchronized nor phased with the uphill or downhill stations.

This independence is consented by the new system of work transport, based on the use of Robocarriers, both for the unisides Robogate and for the body Robogate.

The Robocarriers have two pivoting drive wheels, driven by electric c.c. motors, and two pivoting idle wheels; the motors are supplied by accumulators that are recharged every night.

On each carrier a hydraulic device provides lifting the pallet in every station and depositing it onto calibrated rests for correct location relative to the robots. The carrier has, on all four sides a rubber bumper, connected with current cut-off switches, and this provides safety in case personnel inadvertently walks or stands on the trajectory of the carrier.

The control is obtained by guidance wires embedded in the floor. The electromagnetic field around such wires is sensed by the carrier antenna and interpreted as a command depending on its frequency distribution.

Conversely, the robocarrier signals its presence at determinate points on its possible trajectories.

Several local control units are disseminated in appropriate points in the shop, and each of these connects one portion of the transport network to the central control system (Digital P.D.P. 11 minicomputer).

The central control unit, among its other tasks, takes care of controlling the traffic of the Robocarriers (which are approximately 25 in each module), by providing or denying power supplies to the local control units, avoiding carrier collisions at network intersections, preventing traffic jams from originating, halting the carriers when necessary and restarting them as soon as the situation permits, or deviating them along alternative trajectories.

All this occurs in the maximum quietness (so quiet as electric vehicles can be).

The unisides in one case and the bodies in the other case do not rest directly on robocarriers.

The support is arranged to occur by means of an intermediate structure, the pallet which has the purpose to sustain and clamp in the correct position the group of subassemblies which is placed upon it, for the entire duration of the process in the various stations. The base of the pallet on the other hand has a universal configuration, so that any pallet may rest upon fixed positioning pins which find themselves on each Robocarrier.

It is foreseen that in the future our Robogate systems will handle bodies of different shapes and sizes, so that different pallets will be required. The systems are therefore arranged so that they may be equipped with warehouses of pallets, capable of automatically exchange pallets on the standard robocarrier, when this is requested by variations of the mix to produce.

Referring to the case of the body, the four subassemblies that compose it (underbody, R.H. and L.H. unisides, roof) are kept together fairly well by the pallet. However, before starting to weld, the four subassemblies (which initially are only toy-tabbled with one another) are clamped in a geometrically positive way. This is the task of the swinging gates which, prior to tack welding, automatically swing closed against the body and actuate their clamp.

At this point the robots apply the first 70 or 80 spots the ones that begin to give a cer-

tain rigidity to the body shell, the so-called tack-welding spots.

The change of the car type requires the replacement of the gates during the cycle time and controlled by the computer.

In the subsequent stations, where the gates are not required any more, all the necessary completion operations are done, till the complete working program is performed.

The basic cycle for the material flow in the system starts from the loading station, where the parts are automatically deposited on an empty pallet arrived at this station on board of a Robocarrier.

The Robocarrier is then sent to the various stations of the module, by keeping into account the requirements of the loaded module.

At the end the Robocarrier, carrying the welded body, is despatched to the unloading station, where an elevator automatically picks up the body and sends it by conveyor to the subsequent operations. The carrier remains with the empty pallet and can then start another cycle, by moving itself into the loading station.

The operations which are performed within the Robogate system, like the weld spots applied at any station or the displacements of any Robocarrier from one stop location to the next stop location, are all effected under control of several local control units, everyone of which covers only a certain type and a certain quantity of activities.

Coordination of all these control units is then assigned to a fairly powerful computer, which supervises all that happens in the Robogate module, that is :

- it programs the sequence of the work operations;
- it distributes the resources of the installation;
- it starts, controls and verifies the good result of operations;
- it keeps and continuously updates the situation of the system and the various statistics on production date and efficiency of the system.

To obtain all this, between the installation and the computer a great flow of information travels continuously under the form of electric signals.

The computer through its terminals (teleprinters and C.R.T. displays) communicates or rather dialogues with the operative and the maintenance personnel.

The computer gives or conversely receives all the useful news, above all it signals when human intervention is necessary, which is the case only in the event of a malfunction of some component of the installation, besides of course the necessity of human control to start and to stop the activities of a working shift and to recall statistics on the production.

One more feature we would like to mention; the system, besides the traditional process controls, provides a very strict and unbiased type of quality control, as it is an automatic control; the quality of every spot weld applied is checked and if defective is monitored.

In such cases it is possible to timely repeat those welds which in the first run have not resulted successful.

CSO: 3102/428

TRANSPORATION

ALL-PLASTIC BICYCLE FORESHADOWS FUTURE AUTOMOBILES

Stockholm DAGENS NYHETER in Swedish 2 Sep 81 p 12

[Article by Peter Sandberg]

[Text] In 1977 Volvo began thinking about manufacturing a compact car with large portions made of plastic. The first results from this project were presented Tuesday in Gothenburg--a bicycle.

The company that developed this plastic bicycle, Itera AB, believes it will soon be possible to turn out 300,000 bicycles annually plus a large number of plastic wheels for other bicycle manufacturers.

It has long been a dream to produce a bicycle of plastic. A plastic bicycle would be guaranteed maintenance-free and could be produced with less labor expenditure per bicycle produced. It is also possible that a plastic bicycle could be lighter than a conventional bicycle.

Present bicycle production also includes skilled craftsmanship, for example wheel construction, which causes bottlenecks in production.

Several attempts have been made to manufacture plastic bicycles, but none have made a breakthrough on the market. Now there will be a Swedish attempt.

Injection Molded

What makes this development technically feasible is the rapid development of "composites," i.e. fiber-reinforced plastics. It is now possible to produce light and strong parts made of injection-molded plastic. Composites are used, for example in airplanes and spaceships where precision and reliability are required.

For this reason, it is perfectly natural that several years ago Volvo began studying the feasibility of manufacturing an automobile based on composite technology. It was found that this would be possible some time in the future.

Volvo employees active in this project found that several hundred other products could be made of plastic. The most exciting possibility was the bicycle. For this reason, Lasse Samuelsson and others continued on their own time to develop the

the bicycle project. In 1980 he and marketing executive Jan Olsson, among others, left Volvo to form Itera AB and continue development of the plastic bicycle.

"We worked with the 'Volvo model' and took the best resources as they were rather than designing them ourselves," Lasse Samuelsson said.

In this way, the finished bicycle has become a combination of plastic from Beyer, bearings from SKF, taillights from Arbetsbelysning AB, gears from Sturmey Archer and Simple, brakes from Weinman, etc.

The bicycle will be produced completely in Sweden, however, at the Milhelmina plast AB.

What type of product is this then?

Well, it is a bicycle whose frame has the appearance of a moped. The handlebars are plastic, as are the package carrier and the frame. The light is battery operated and built into the frame. The taillight has diode lamps instead of light bulbs.

The wheels are made of plastic and have eight strong spokes.

Several models are available with 1, 3, 6, or 12 gears. The bicycle is designed for the international market, as seen by the absence of a foot brake. Instead, it has hand brakes on both wheels.

The tires are standard 27 x 1/4 inch.

A test ride indicates that it is rather comfortable to drive, once one is accustomed to the slight springiness of the handlebars.

Full production will begin after the new year. Retailers are being contacted now and the production capacity is about 300,000 bicycles per year, which is just over half Sweden's bicycle sales. So far, 50 to 70 million kronor has been poured into the project. The money has come from STU (National Board for Technical Development), loans from the PK Bank (Joint Post Office and Commercial Credit Bank), and other sources.

If all goes well about 140 jobs will be created at Vilhelmina plastics, which is presently operating at a loss, even though only 11 employees will be involved initially.

The price of the bicycle will be 1,300 to 2,100 kronor, depending on what equipment is included. This will mean competition with conventional, high-quality bicycles such as Monark-Crescent. Marketing is aimed at the Nordic countries and, after a year or so, the rest of Europe.

It is not clear whether or not this product will make a breakthrough on the market. The plastic wheel, however, should be a big seller, since it requires no adjustments, is corrosion-free, and can be used on any bicycle.

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8 October 1981

West Europe Report

SCIENCE AND TECHNOLOGY

No. 77



FOREIGN BROADCAST INFORMATION SERVICE

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ENERGY

NEW TYPE SOLAR CONCENTRATOR BEING DEVELOPED AT CNRS

Paris INFORMATIONS CHIMIE in French Jun-Jul 81 pp 85-86

[Article: "Colored Plastic Solar Concentrators"]

[Text] Given the high cost of silicon photocells, the photovoltaic conversion of solar energy into electrical energy continues to be very costly.

The CNRS [National Center for Scientific Research] Photochemical Laboratory at Thiais has developed a colored polymer film that concentrates the luminous spectrum with respect to flux as well as frequency on to a very small photocell area.

The solar concentrators function in diffused light and do not heat the photocells. They are made of Plexiglass film colored in bulk; unfortunately, the dyes being tested currently--organic molecules developed for colored lasers--are not stable with time and have difficulty in absorbing and re-emitting radiation at the appropriate wavelengths with good energetic yields. The CNRS researchers at Thiais are therefore seeking to develop films enclosing organometallic compounds, that is, organic molecules that include metallic atoms. The luminous energy will then be absorbed by the organic part of the molecule, then transferred to the metallic atom, which will emit it, and so on. Through this process of absorption and emission "in cascade," it is hoped to lengthen the operational life of the dyes and their energy transfer efficiency.

The colored plastic concentrators currently under study have a yield of 10 percent and should therefore enable a tenfold reduction in the silicon area needed for a given level of energy production. Their viability is as yet difficult to evaluate with any degree of precision. The German researchers of the Fraunhofer Institute at Fribourg, who are working in this domain, estimate however that it will be possible very shortly to double the yield of these concentrators and produce electricity at a competitive per-kilowatt-hour cost.

9238
CSO: 3102/419

INDUSTRIAL TECHNOLOGY

FLEXIBLE MANUFACTURING SPEEDS AIRCRAFT PRODUCTION

Duesseldorf VDI-NACHRICHTEN in German 17 Jul 81 p 6

[Article by H. Becker and R.D. Stutz: "Sheetmetal Working Linked"]

[Text] Manufacturing of parts in the aircraft industry is characterized by extremely small runs--even in the case of the high monthly production quantities of the "Airbus" of the MRCA [Multiple Role Combat Aircraft] Tornado"--, in Europe it is currently 4 to 10 assemblies monthly. In extreme cases, a very small run can even mean the individual manufacture of a large number of single sheetmetal parts. The companies therefore concentrate the same parts processing methods for all the models to be manufactured in one place. This concentration of relatively large production quantities allows the installation of technically high-quality plant and an integrated sheetmetal working center, which is now under construction at VFW [Consolidated Aircraft Works] in Bremen.

The many different parts in the construction of an aircraft fuselage constitute the biggest "work package," even ahead of stretch-formed parts, with respect to the duration of manufacture of a single unit. This large volume of parts and the increasing need for capacity are forcing an expansion of the possible manufacturing methods, which is possible only by applying new technologies with an adequate degree of mechanization and process-oriented interconnection. The target must be to make current sheetmetal parts manufacture more efficient and improve parts quality. Reducing manual operations is a prominent and important aspect of this goal.

In the Integrated Flexible Metal Parts Manufacturing Center (IFBZ), as it is currently under construction at the Consolidated Aircraft Works (VFW) in Bremen, a broad spectrum of parts has to be processed: a large number of diverse parts passes through the plant in small lots and in different operational sequences. This not only makes great demands on the flexibility of the system components but also on the efficiency of an inventory and supply system linking the individual components and of a matching control system.

Hierarchies of Computers

Each subtask of the IFBZ is controlled and monitored separately. The IFBZ is arranged hierarchically with respect to the use of computers and controls.

The task of the lowest level is switching, controlling and monitoring the functions of the subtasks displayed. On this level, operation of the plant sections is possible manually, even in an emergency. The superior computer on the next level carries out the automatic operation of the subsystems. The entire IFBZ is controlled by a master computer for manufacturing, which receives general conditions from a superior production engineering and control system.

The functional capability of the control system is dependent on access to data files, particularly those with inventory stock data, technological data and data for monitoring the progress of orders.

The gradual conversion of the individual steps in the process will be followed by the integration of the subsystems, which will then be working at optimal maximum with the parallel expansion of the Airbus program.

The sheetmetal parts are made from a flat blank. Angles are formed by simple bending, rib sections, spar sections and U-sections, whose arms are stretched or compressed in the forming process. If necessary, the arms can be given passages during the same forming; the webs are given braces or flanges to increase part rigidity. The material is mostly copper- or zinc-alloy aluminum.

The materials harden by precipitation, so before forming they have to be made ductile by heat-treatment, which in the case of solution treatment is nonstable. The thickness of the pieces to be processed is in the range between 0.8 mm and 2.5 mm. The size of the pieces varies from the magnitude of a bulkhead corner to spar sections with a length of 2.5 ms.

The manufacture of sheetmetal parts using previous methods is characterized by numerous, almost craftsman-like operations: making blanks with shears, drilling holes with drilling jigs and hand-machining of billets using contour templates. Parts are still largely deburred by hand. During heat treatment, the parts are dipped by hand into saline baths, and the quenching in water is also carried out by hand. Before forming the heat-treated blanks must be leveled in order to guarantee a precise fit in the machine tool. Depending on the workpiece, formation is by bending in the bending press, by hand or, in the majority of cases, by pressure forming.

A flexible method for pressure forming, adapted to the multiplicity of parts and the small quantity per part, has been used in the aircraft industry for many years. One-piece machine tools (dies) are used, with the shape of the finished workpiece.

The "matching tool" is a rubber diaphragm or rubber pad with a Shore hardness of 60 A. The rubber diaphragm, which is under load from high-pressure hydraulic oil, or the almost incompressible rubber pad shape themselves around the tool when the presses come together and form the metal blank into the desired part.

In this forming process the tools lie on the machine table, which can accept 3 to 15 tools, according to the size of the table and the part tool.

The pressure applied in this technique is a maximum of 300 bar in machines installed in the FRG. This relatively low figure makes it necessary for more than 50 percent of all the parts, which cannot be finally shaped because of springback, to be worked

on by hand afterwards so that they meet quality standards. The press configurations in use do not permit any separation of pressing time and manual work time, so that the capacity limit is reached quickly when demand grows.

Adapted to Aircraft Fuselage Construction

Sheetmetal parts manufacture, therefore, had to be automated and mechanized to meet the problems of fuselage construction. This means examining every workstep to see if it can be altered and improved.

The steps of cutting the rough blank, drilling receiving holes, packaging and processing the final blank could be combined by using the CNC computer-assisted numerically controlled drilling and machining center 3000 bfz (Trumpf, Ditzingen). The machine can cut the blanks for the parts from packaged sheets and produce the drillings required. The package of sheets is riveted to a carrier plate, the parts blank to be machined is likewise held by two rivets, and the machine puts in rivets along the cutting line to take the cutting forces. Drilling, riveting and contour milling with five processing units are program-controlled.

The machine is designed so that not only single rough blanks can be used, as is done with manual machining, but the parts blanks are cut from packaged standard-size sheets (1.25 ms X 2.50 ms). The individual parts are arranged closely on the standard sheets, resulting in a more efficient use of material.

The machine is supplied from an inventory assigned to that particular processing station, in which the carrying plates and the bundles of sheets are kept ready.

The next workstep is deburring the parts. Manual deburring is to be completely eliminated in the future.

For parts with an edge length exceeding 100 mm, an installation is being planned which can debur and clean the blanks on both sides in one step. The grinding method will be used for small parts with edge lengths under 100 mm.

The parts blanks can be identified by comparing them with an available "Trumatic" blanks plan: as an alternative the use of an optical-electronic sensor is being studied at VFW.

With the help of a TV camera, which transmits specific parts data to a process computer, an installation like this can recognize profile contours. The parts are then given the necessary identification mark and held in readiness for further processing. The greater part of the blanks must be heat treated prior to forming. Recirculating hot air ovens and saline baths are used for annealing and solution treatment. The quenching in water which follows solution treatment causes a greater or lesser degree of distortion in the parts, which has to be corrected by putting them through a straightening roller.

If a water and glycol mixture is used for quenching, distortion of the parts can be prevented almost entirely. In addition to preserving the solution treatment state

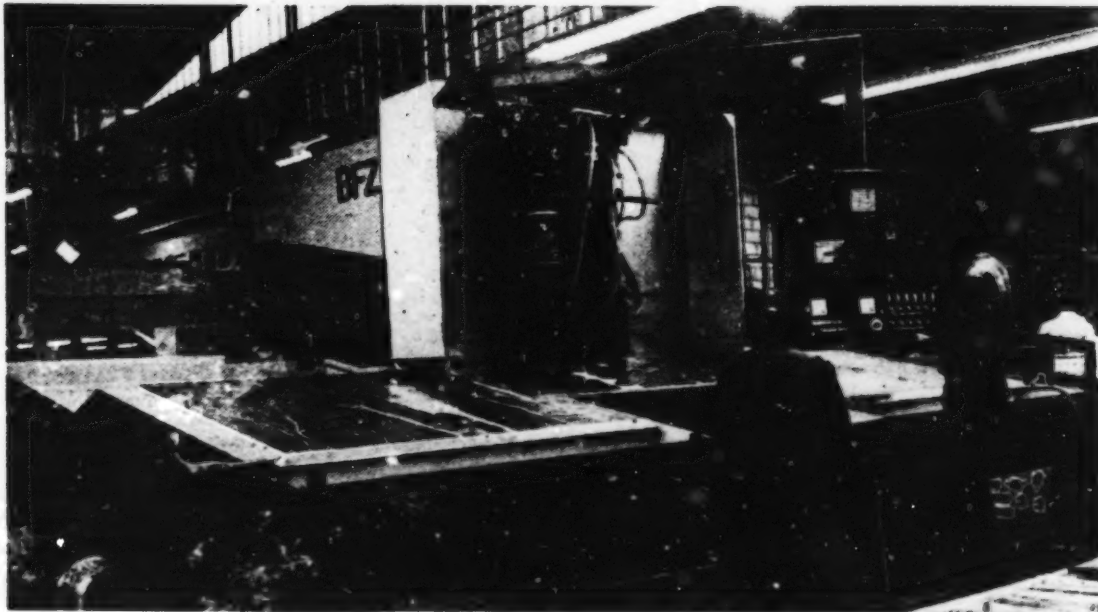
undisturbed until forming, there is also the possibility of forming annealed parts, of applying solution treatment after forming and obtaining distortion-free parts, at the same time as the time link between heat treatment and forming is done away with.

At forming pressures of about 300 bar, the parts exhibit considerable springback, which involves considerable finishing work until the part is finally shaped. Springback is reduced with increasing pressure.

A high-pressure press from Siempelkamp in Krefeld, with a table size of 1,375 mm X 2,770 mm = 3.8 m² and an applied pressure of 260 MN, exerts a forming pressure of 700 bar. The press operates with a rubber chamber with a 400-mm thick polyurethane filling, allowing part heights up to 150 mm. In contrast to diaphragm presses a forming pressure of up to 1,000 bar, an increase in pressure can be achieved with this type of press construction by reducing the size of the rubber chamber and of the press table dimensions. With the Siempelkamp press, pressures up to a maximum of 2,500 bar can be obtained with a table surface of 700 mm X 1,120 mm. The effects of these pressures up to 2,500 bar on springback rates and the reproducibility of parts, as well as the design of tools and the forming of other materials, are still being investigated. Tests are being carried out with test tools specially developed for this purpose.

The press operates on the run-through principle: production pallets with tools and parts blanks are fed to the press on a rotating system and removed from it again. By using this system of rotation, the average press cycle time of 2 minutes can be maintained. The entire operation of feeding the press and the forming itself can be monitored and controlled from a press master console; control is manual or fully automatic.

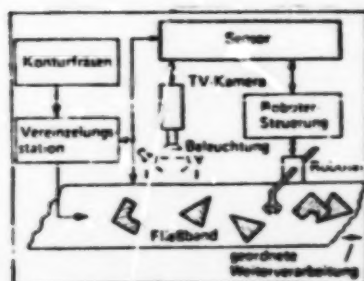
This press design, with its circulation system, offers a substantial increase in productivity compared with the current method. With an average press table content of 12 tools and a utilization of 85 percent, up to 1 million parts annually can be formed with two shifts working. The use of forming pressures of 700 bar promises about 50-percent reduction in the parts finishing operations previously needed. Full testing of all systems and their integration into the full plant--under a technology support program with the BMFT Ministry for Research and Technology--will be completed by 1983.



With the CNC [Computer-Assisted Numerically Controlled] Drilling and Machining Center "Trumatic 3000 bfz" several layers of metals are processed in one operation. The parts blank to be cut is held in position by rivets.

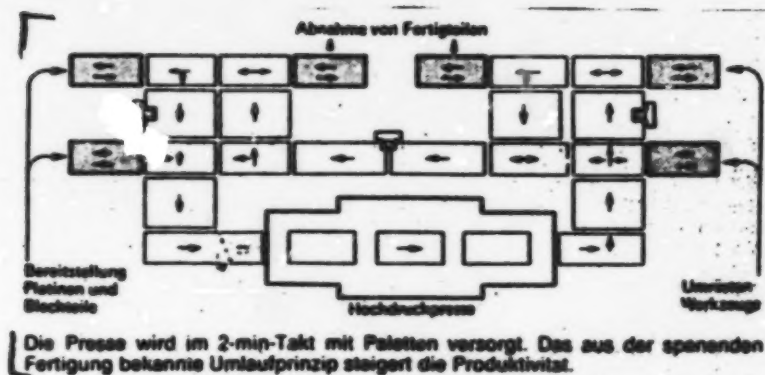


The high-pressure, circulation-system press from Siempelkamp in Krefeld has an applied pressure of 260 MN. It can generate forming pressures up to 2,500 bar, which minimizes springback of the formed metal parts.



Sensor
Profile milling TV camera Robot control
Separation station Lighting
Robots
Conveyor belt
Additional machining

The numerous different parts blanks are automatically identified.



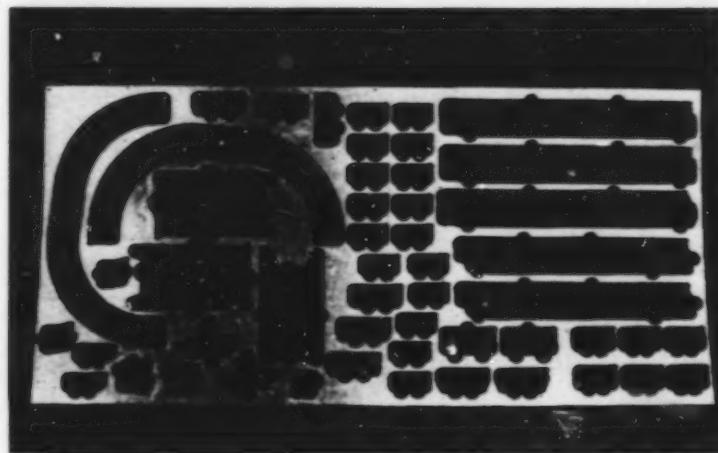
Delivery of Finished Parts

Billets and Sheetmetal
Parts Ready for Use

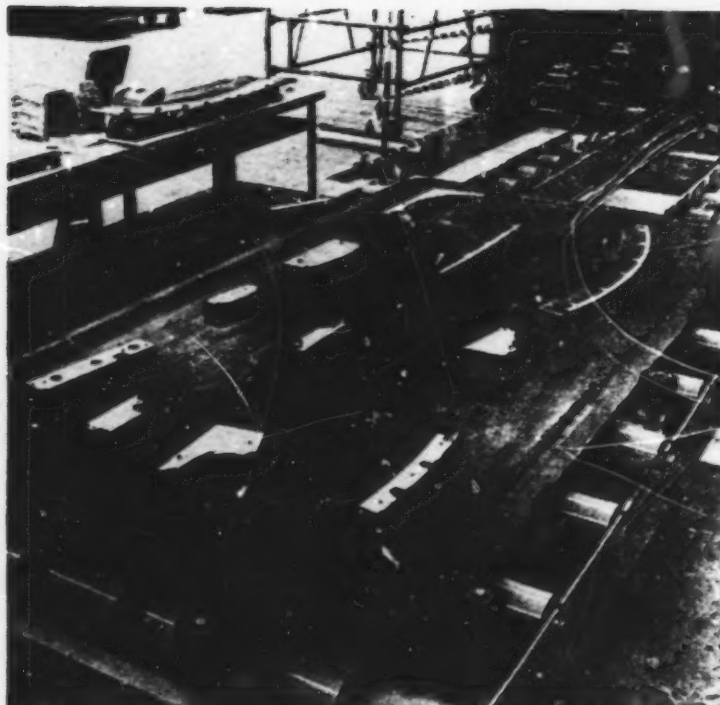
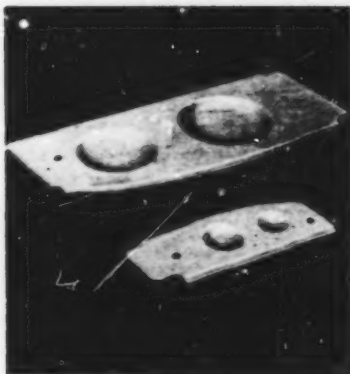
High-pressure Press

Changeover
Tools

The press is supplied with pallets in 2-minute cycles. The circulation principle familiar from cutting manufacture increases productivity.



The lattice remaining from a CNC-cut sheetmetal package: the individual parts were interlocked on the standard 1.25 m x 2.50 m sheet.



The sheetmetal parts for aircraft construction are aluminum alloy and are manufactured by pressure-forming with a one-piece tool (die) and a rubber form.

9581

CSO: 3102/399

SCIENCE POLICY

RESEARCH MINISTERS DISCUSS R&D ORGANIZATION, COOPERATION

Duesseldorf VDI-NACHRICHTEN in German 31 Jul 81 p 1

[Article: "Research and Development Activities in France Regrouped"]

[Text] During the German-French discussions on July 13 in Bonn, the French minister for research and technology, Jean-Pierre Chevenement, revealed to his German counterpart Dr. Andreas von Buelow the research policy plans of the government under President François Mitterand. For the first time France will have a coordinating ministry for research and technology.

French governmental and industrial outlays for research and development (FuE) will be increased from 1.8 to 2.5 percent of gross social product by 1985.

The new French Ministry for Research and Technology is patterned after the German Federal Ministry for Research and Technology (BMFT). It will take over the tasks of the former governmental coordinating committee Délégation Générale à la Recherche Scientifique et Technique (DGRST), which was previously under the Federal Secretary for Research; and it will absorb the Delegation à l'Innovation et à la Technologie (DIT) which was under the Ministry for Industry. In addition, the Minister for Research and Technology is responsible for the Centre National de la Recherche (CNRS) which, with more than a third of the government's research budget, primarily supports basic research in the universities and in approximately 160 government institutes.

Also assigned to the Ministry for Research and Technology are the technology utilization association Agence Nationale de Valorisation de la Recherche (ANVAR), which was formerly under the Minister for Industry, and the documentation agency Mission Interministérielle de Documentation et d'Information Scientifique et Technique (MIDIST). The remaining government research organizations and institutions remain with the individual departments except in matters relating to budgets, structural changes and employment questions concerning scientific personnel; the Ministry for Research and Technology is now responsible for these items.

According to a survey by the former science advisor in the French embassy in Bonn and present director of the international division of DGRST in the Paris research ministry, Jean-Pierre Chevillot, French research and development outlays have already increased in the 1980-81 period: The actual research title in the federal budget (enveloppe recherche) by 17.8 percent from FF 10.33 to 12.17 billion, civil research in the universities outside of this title by 14 percent from FF 2.97 to 3.39 billion, the technology title by 28.4 percent from FF 7.15 to 9.18 billion and the military research program by 15.6 percent from FF 11.25 to 13.0 billion.

The total French budget for research and development increased from 1980 to 1981 by 19.1 percent from FF 31.7 to 37.7 billion compared to the total federal budget increase of only 12.5 percent from FF 532 billion to 600 billion.

The first discussion between von Buelow and Chevenement centered on energy and space research and technology. Chevenement assured the continuity of the French (nuclear) energy policy and research and also the maintenance of the COGEMA reprocessing agreement for the disposal of German nuclear power plant waste. Both countries will devote special attention to the German-developed technology for the gasification of coal in situ for deposits which are hard to mine. Further development of the European booster rocket Arian will be a topic for a later meeting. The next round of discussions involving the two ministers includes microelectronics, humanization of work life and comprehensive coordination of large investments in basic research.

9160

CSO: 3102/408

SCIENCE POLICY

RESEARCH MINISTER INTERVIEWED ON INDUSTRIAL R & D PROGRAM

Paris L'USINE NOUVELLE in French 10 Sep 81 pp 56-57

[Interview with Minister of State for Research and Technology Jean-Pierre Chevenement by Marc Chabreuil: "Research and Technology: 'Industrialists, Speak Up'"; place and date of interview not given]

[Text] Starting in October, regional seminars in research and technology will be held in each region. They are to be a kind of vast get-together which, having led to a concluding national convention, are to serve in drawing up the government's scientific and technological policy for the next 4 years.

Whether they actually accomplish this purpose or whether some of the recommendations emerging from them eventually end up partially "buried," industrialists will have had a unique opportunity to make themselves heard, to make known their problems, their needs, to dialogue with university people and scientists. This is the desire of Jean-Pierre Chevenement, minister of state for research and development, who, in an exclusive interview granted to L'USINE NOUVELLE, disclosed also several projects favoring industrial research.

[Question] Will the industrialists be invited to take part in the Research and Technology Ministry's regional seminars?

[Answer] Of course. Indeed, the participation of the industrialists is highly important. To make known their needs, their concerns, to talk with the active forces in their regions.... But also because the major issues to be taken up at the national convention will be debated in these regional-level meetings--particularly, the problems posed by development and technology, the insertion of research into enterprise strategies, and the insertion of the regional dimension into the national scientific and technological policy.

Besides, the industrialists are already a party to the preparation of these seminars: as chairmen of organizing committees, which are in the process of being formed in all the regions (this is the case of five industrialists); as members of these committees together with representatives of universities, of public and private research bodies, socio-occupational associations (chambers of commerce, trade unions, associations, economic and social committees...); or even as mere participants.

[Question] Who will be speaking for the PMI [Small and Medium Industries]?

[Answer] I hope that many PMI heads of firms will personally take part in these seminars. This will be an opportunity for them to talk with scientists, university people, and regional representatives of organizations like ANVAR [National Agency for Valorization of Research], and to gain information on the potentials of regional research... Two PMI company heads have set an example by accepting the chairmanship of seminar organizing committees for the Rhone-Alpes and Corsican regions.

A very extensive coverage of information on these seminars will be disseminated among the PMI's. The chambers of commerce, the ANVAR regional delegations, the professional associations will all provide channels through which we can reach the PMI's. To give you some idea, 30,000 copies of the preliminary documentation for the convention will be distributed!

[Question] Do you already have planned incentives to encourage industrial research?

[Answer] It would be premature to disclose all of them. If only because I must still discuss them with Jacques Delors and Laurent Fabius.... However, I have already included in the draft budget for 1982 a budgetary package for ANVAR which represents a substantial forward stride: Fr 760 million versus Fr 450 million this year. And to encourage private enterprises to increase their research effort in comparable proportions to what is being done in the public sector, I am considering several solutions. To stimulate contracting between enterprises and laboratories, certain tax relief measures (for example, the VAT [value-added tax]) could be added to existing incentive measures (innovation bonuses). Certain fiscal measures could stimulate the employment of young researchers, as in the FRG. Besides, a percentage (to be defined) of the cost of industrial research work contracted with public laboratories or with a technical center could be made tax-deductible. This would be an innovative measure, an incentive for enterprises that would also enable certain technical centers to break away from their isolation.

To attain our goal (2.5 percent of GDP [gross domestic product] on research by 1985), our industrialists must by then be spending close to Fr 50 billion in 1980 francs (or Fr 20 billion more than today) on R & D. Of course, our state enterprises, which will represent half of the industrial research effort, will have to make a special effort to become real technological developmental poles.

[Question] Do you expect these seminars to produce new formulas for the transfer of the results of public sector research to the industrial sector?

[Answer] This is an essential requirement to valorize the nation's research potential. This objective will be addressed during the seminars, and the Organizing Committee for the national convention has already put in place a Research, Technological and Industrial Working Party. This working party will carry out a study of current constraints on innovation and its diffusion, and will propose new formulas for the transfer of research results to industry. The problem to be

addressed here is a more general one than that of scientific and technological information and its dissemination. I consider that a systematic effort must be made in the regions to enable enterprises to have access to acquired know-how and to technical updating.

[Question] Will such an effort involve the institution of technological and industrial forecasting?

[Answer] That is indispensable to the drawing up of research strategies and technological policy decisions. In recent years, this fact has been underestimated, almost totally neglected. I plan therefore to reevaluate the role of futur-ology. Two National Convention working parties will examine this important question.

A great deal of talk is being devoted to the pluralism of economic forecasting. That is all very well and good. But with numerous indicators, calculated on different bases, what we have is a pluralism of Babel! Would it not be more sound to create a large-scale Institute of Scientific and Technological Forecasting?

[Question] When will enterprises be able to perceive the first concrete results from this vast coactive national planning effort?

[Answer] The work of the regional seminars will be completed by the end of November. Their combined findings will be presented to the national convention that is to be held in Paris from 13 to 16 January 1982. The enterprises will be able at that time to become conversant with the outcome. A major portion of the proceedings and combined reports will be addressed to them. For my part, the findings of this national consultation will enable me to introduce, into the program bill covering the period 1982-1985 as well into other acts, measures favoring industrial research. This is what will open for us the "emergency exit" from our crisis.

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SCIENCE POLICY

BRIEFS

RESEARCH MONEY--The French Minister for research and technology, Jean-Pierre Chevènement, has announced that the research budget will be increased from about FF 50 to 80 billion between now and 1985. In addition, he projects the creation of 525 new positions for scientists and engineers. He also wants to restore basic research and human and social research to a high position. Three programs (biotechnology, microelectronics and new energy sources) will have priority. [Text] [Duesseldorf EUROPA CHEMIE in German no 21 Aug 81 p 353] 9160

CSO: 3102/408

TRANSPORTATION

AERODYNAMICS OF HIGH-SPEED WHEEL-ON-RAIL TECHNOLOGY STUDIED

Cologne DFVLR NACHRICHTEN in German Jun 81 pp 1-7

[Article by Paul-Armin Mackrodt: "The Aerodynamics of High-Speed Trains"]

[Text] The Ministry for Research and Technology (BMFT) is subsidizing a program of research into the technical-economic limits of wheel-on-rail systems. The DFVLR (German Research and Development Institute for Air and Space Travel) has played a major role in this work. It studied the possibilities of making improvements in the areas of riding dynamics, aerodynamics and aeroacoustics. The following article gives a survey of the work conducted on high-speed rail aerodynamics.

In the decades after World War II many railroad companies found themselves faced with growing competition from the automobile and the airplane. While long-distance passenger traffic, for example in the United States, declined sharply as a consequence, the railroads in Japan and Europe made and are making efforts to meet this competitive pressure by improving the services they offer. One important component of this improvement is without doubt a reduction in traveling time, which, besides tightening the schedule, can only come about by drastically increasing train speeds. Japan made a start there with the Shinkansen express, which, since 1965, has been running with a maximum speed of 210 km/hour on the Tokkaido line, opened for service in 1964. In Europe, Italy, France and Great Britain followed more or less simultaneously; their railroads have been attaining top speeds of 200 km/hour since 1976/77 on individual lines with special trains (Aquitaine, Capitole, High Speed Train/HST). With the 1978 summer schedule the Federal German Railroads likewise introduced 200 km/hour as its highest speed on some, still quite short, stretches of the InterCity network. Additional increases in speed are already being planned in all the countries mentioned: With the Shinkansen II in Japan, the ETR (High-Speed Electric Train) 401 "Pendolino" in Italy and the Advanced Passenger Train in Great Britain (fig. 1), trains entered service in 1976/78 (at first only on an experimental basis) which, after 1983/85, will travel at speeds of 250 km/hour on specially modified sections of line. France even went one step further: The French railroads (SNCF) had already taken delivery, by the spring of 1981, of more than 20 TGV (Train a Grande Vitesse) [High-Speed Train] (fig. 2), which will be put into operation, beginning in October 1981, on the newly constructed line between Paris and Lyon at scheduled speeds of 260 km/hour and, in the second stage of expansion (after about 1995), at top speeds of 300 km/hour.

The German Federal Railroad is lagging far behind in its plans. Not until the second phase of expansion of the newly constructed sections--so, not before the year 2000--is a scheduled top speed of 250 km/hour envisaged. This is particularly regrettable if one recalls that the German Railroad was a world leader in the field of high-speed transportation in the 1930s: Speeds of 160 km/hour were attained regularly on some stretches in 1933, and from 1931 to 1955 Kruckenberg's propeller-driven locomotive "Schienenzepp" held the world rail speed record at 230 km/hour.

In order to compensate for the lag of the Federal Railroad, the Ministry for Research and Technology has been financing a research program into the technical-economic limits of the wheel-on-rail system (R/S program) since 1975; besides the DB, the locomotive and coach construction industries and the aircraft industry, the DFVLR is also participating (in the areas of riding dynamics, aerodynamics and aeroacoustics). The goal of the program is to develop a wheel-on-rail experimental and demonstration vehicle (R/S-VD), which, beginning in 1983, should reach 350 km/hour in test runs on the railroad test facility (EVA) at Rheine-Freren as a three-section train (two driving units and one intermediate coach) and, on the new and improved DB routes, 300 km/hour with 400 passengers.

In this speed range, aerodynamics assume a very much more far-reaching importance than at the speeds attained previously. In fact, aerodynamic requirements determine the external shape of the vehicle (and no longer operational requirements, which had always taken absolute precedence previously).

What are the requirements for a rail vehicle with an "aerodynamically favorable" shape? The first and most important is that air resistance must be as low as possible, because at 350 km/hour more than 90 percent of the rolling resistance* is air resistance, that is, changes in air resistance have an almost complete and direct effect on the power of the propulsion unit to be installed and therefore on the weight of the vehicle and its total cost. Second, the other aerodynamic forces and moments must not exceed certain limits, in order not to exert a dangerous influence on the running characteristics of the vehicle. Third, the aerodynamic effects of the train on its environment through the pressure wave and wake and their retroactive effects on the train itself (for example, when passing stationary objects or entering a tunnel) must remain under certain tolerances. Fourth, sources of aerodynamic noise must be avoided; a report on this will appear shortly in the DFVLR reports.

The demand for minimal drag is fulfilled when no breaks in contour (for example, vents, handles, buffers, transitional gaps) are present, and the airflow does not separate from the vehicle surface anywhere. Separations occur where the airflow has to move against rapidly increasing pressure, that is, downstream from areas of high negative pressure ("suction peaks"), such as occur on surfaces with a sharp convex curvature (edges). Shapes like this must be avoided. The second requirement usually fulfills itself: Only nonsteady peak loads from wind gusts need to be absorbed through suitable design of the carrying and guidance system. That is the job of ride dynamics. The need for low pressure disturbances determines a cross-section surface along the length of the train that increases gradually at the nose and decreases gradually at the tail, or, tapered shapes. Sources of aerodynamic noise occur in areas of excessive velocity, that is, in regions with curves of a sharply

*Rolling resistance is the total resistance to motion that a railroad train has to overcome at a constant speed on a level, straight track.

convex contour; they can become particularly intense if individual components (insulators, current carrying pantograph, handles, buffers) project beyond the vehicle outline. This means that all the demands of aerodynamics and aeroacoustics point in the same direction: Towards smooth vehicles, slender at the nose and tail, with only gently curved surfaces. The vehicles used by the Federal Railroad do not yet meet these requirements. Only during the design of the 103, 403 and 601 locomotives whose specifications were laid down for high speeds, were aerodynamic requirements considered.

The newest DB vehicles, the 111 and 120 electric locomotives, once again conform more to operational requirements and a prescribed design. This is surprising, at least in the case of the three-phase current 120 locomotive, because, with the anticipated long life of this locomotive (about 40 years) and the large number to be acquired (reportedly about 2,500), it is unavoidable that numerous units will be equipped for speeds of 200 km/hour. The 120 in its present form is poorly suited for these speeds; its drag is about 90 percent higher than that of the 130, as our measurements in the DFVLR 3-meter wind tunnel in Goettingen showed. These figures apply only to the engine running by itself, but with a 7-coach train traveling at 200 km/hour about 10 percent of the propulsive energy could be saved by adapting the shape of the 120 more closely to that of the 103. The technical changes to the 120 that are still possible, and as proposed by the DFVLR following extensive wind tunnel measurements, would reduce the drag of the locomotive running by itself by 25 percent. Although the drag of the locomotive running by itself by 25 percent. Although the drag of the first coach increases slightly as a result of these improvements, the resultant gains are not quite 6 percent for a 3-coach train, 4 percent for a 7-coach train and 3 percent for an 11-coach train. The DB has since confirmed that these figures are realistic: During rolling tests with the original locomotive 120 005 in its original form and with the improvements we recommended, drag was reduced by 5 percent for a 3-coach train. These savings are small to be sure, especially since energy costs for driving a train are only a minute fraction of the total costs of the DB. Nevertheless, a 3-percent saving in rolling resistance means that 75 out of the 2,500 engines are, so to say, running for nothing, and that is still about one-half of the locomotives operating today on the InterCity service.

If such minor changes in the vehicle's shape reduce drag noticeably at 200 km/hour, it is clear that totally new shapes are needed for the R/S V-D, which is supposed to reach 350 km/hour. As part of the DFVLR project "High-Speed Rail Aerodynamics," the DFVLR Institutes for Aerodynamic Design and Experimental Fluid Flow Mechanics jointly designed noses for the driving unit of the R/S V-D, which conform to the requirements for aerodynamically optimal vehicle shapes enumerated above. To make the design work more efficiently, G. Steffers developed a method by which the nose forms are selected by computer programs from predetermined planform and side elevation curves. With the aid of these programs not only can entire series of a family of locomotives noses described by the boundary curves be generated by varying the parameters, but all the surface points needed for panel computation and the production of wind tunnels models by the NC New Construction milling machine can be found. In addition to ellipses (GE, MD, and ME families), the boundary curves employed were primarily fourth-degree curves (ovals of Cassini for the SC families and super-ellipses for KS and SD families), which have the advantage of making the transition to straight lines (here the cylindrical part of the train) without abrupt changes in curvature. (Collecting points, which can cause separations, occur at abrupt changes in curvature.) From the shapes designed in this way, eight locomotive noses

were finally selected as representatives of entire families and tested theoretically and experimentally in parallel (fig. 6). The theoretical work extended to calculating the pressure or velocity fields on the models' surface and in their environment with the aid of the panel method developed by J. Steinheuer and G. Stoffers. The reliability of this method had already been proved by a comparison with pressure measurements on a model of the 103 and on the original French TGV train, so that pressure distributions had to be measured on only a few models, which were in good agreement with the results of the calculations, as expected. The calculated velocity fields on the surface of the models provide important clues on all models about areas prone to separation and regions where sources of serious aerodynamic noise can be expected.

All these considerations led us to propose construction of a somewhat shortened nose from the KS series, the KS 20 shape, which is shown in fig. 13 as a panel model. The pressure wave parameters of this shape, which we determined by shifting the values for KS 30 parallel to the curves in fig. 7 along the broken lines to the degree of slimness corresponding to that of KS 20 (solid triangles), are clearly more favorable than those of the comparably slim noses MD 10 and SC 31 and of other guarantees meeting the noise standards. A 1:10 scale model of the KS 20 nose has now been numerically machined in the DFVLR workshops in Goettingen and measurements have been taken by the Krauss-Maffei Co. in the SNCF wind tunnel at St. Cyr near Paris. The results confirm the DFVLR predictions in an impressive way. For example, a drag coefficient of $0.52 \pm$ percent was measured on the three-part model. From our measurements we had calculated: Lead car: $C_d = 0.11$; middle car (according to measurements by the Technical University of Hannover on a model of the 403): $C_d = 0.09$; rear car: $C_d = 0.5$. coefficient of drag at the rear + drag coefficient of the lead car = $0.5 \cdot 0.2 + 0.11 = 0.21$; current collecting pantograph: $C_d = 0.1$; the total for the three-part train: $C_d = 0.51$. In no small measure on the basis of this good agreement the nose shape KS 20 proposed by the DFVLR was officially established for the R/S V-D by the Federal Railroad.

In order to ascertain reliably the aerodynamic forces attacking the final version of the vehicle and its environmental effects (pressure wave, wake, noise), measurements must still be taken on a 1:5 scale model, on which all the details, for example, the pantograph, bogies, doors and windows, can be reproduced and the inlets and outlets for cooling air can be simulated realistically.

The airflow under the vehicle must be correctly modeled to determine aerodynamic forces accurately, which requires a moving wind tunnel floor. The most suitable facility for this would be the new German-Dutch wind tunnel (DNW). In addition to this, the pressure loads occurring when passing obstacles close to the track and when entering tunnels must also be calculated using the unsteady (quasisteady), three-dimensional panel method, because previous measurements and calculations are valid only for the steady case of traveling past an infinitely long wall. The development of a three-dimensional, genuinely unsteady method of computing pressure flow in time and space while passing through a tunnel is not complete. Finally, measurements on the original R/S test vehicle, scheduled for 1983/84 on the Rheine-Freren line, must be prepared. Unfortunately, because of a shortage of staff openings in favor of other, even more important projects, the DFVLR institutes involved are being forced to end their work on high-speed rail aerodynamics for the time being in 1981. We confidently hope that at least some of the openings for 1982 that we requested are made available, so that the work considered important and valuable by the research partners can be continued after 1981.

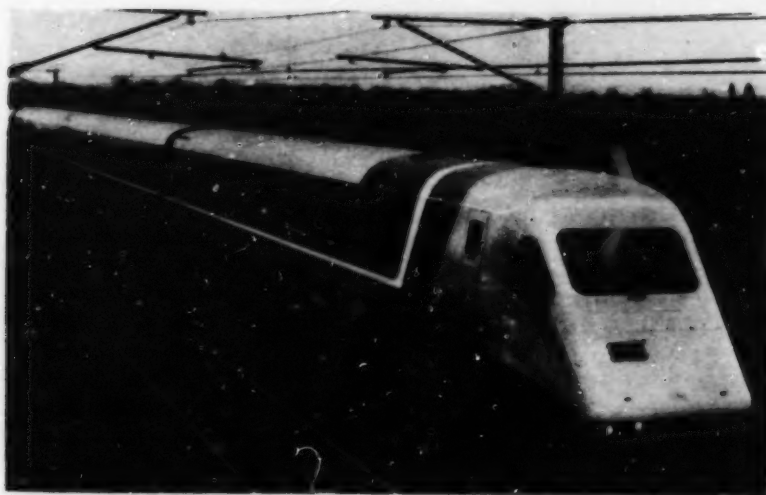


Fig. 1 British high-speed train APT (Advanced Passenger Train) for a top speed of 250 km/hour



Fig. 2 French high-speed train TGV (Train à Grande Vitesse) for a top speed of 260 km/hour.

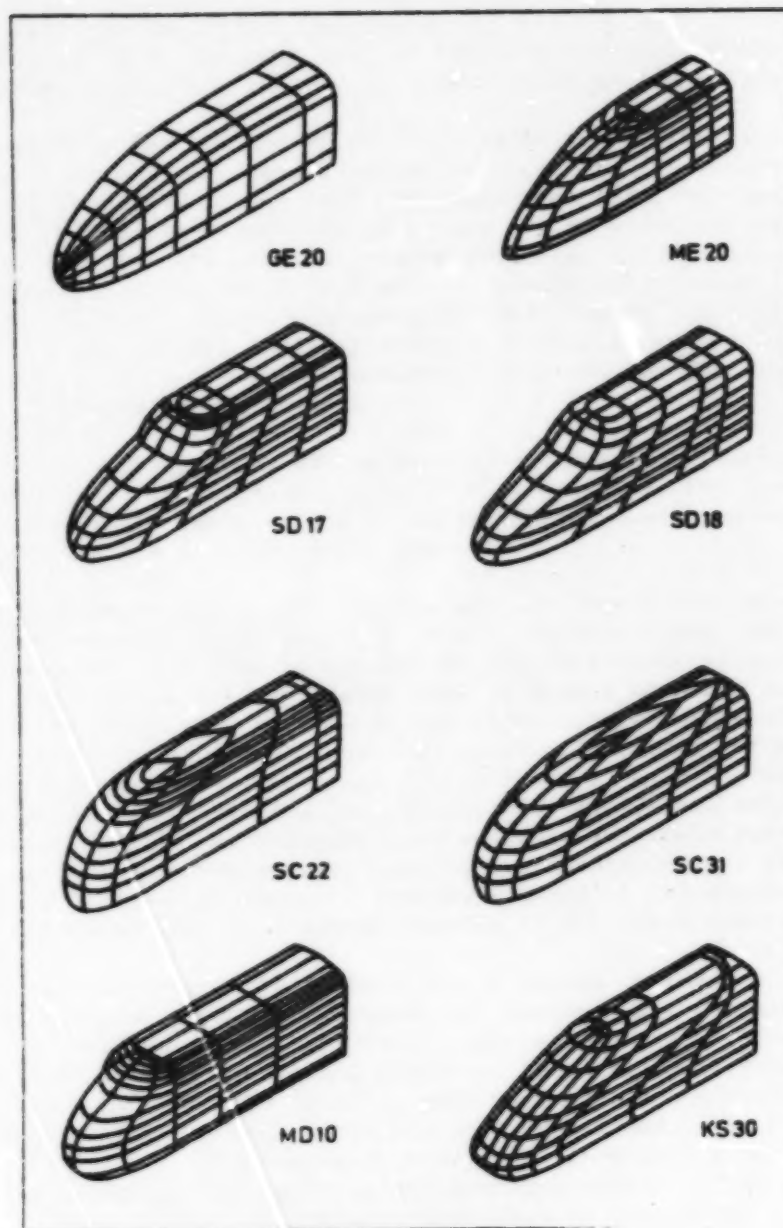


Fig. 6 Panel drawings of engine nose shapes designed and tested by the DFVLR.

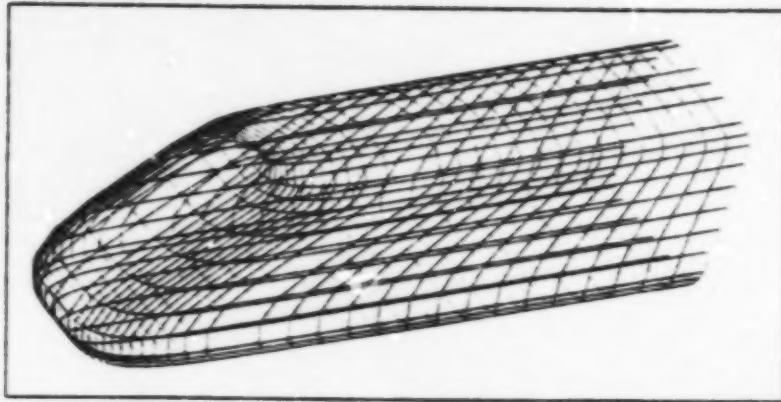


Fig. 13 Perspective computer graphics drawing of the KS 20 engine nose form

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CSO: 3102/397

TRANSPORTATION

STATUS OF MAGNETIC LEVITATION TECHNOLOGY EXAMINED

Wuerzburg AUTOMOBIL-INDUSTRIE in German Jun 81 pp 205-211

[Article by Hans-Georg Raschbichler: "Magnetic Levitation-Technology for Future Transportation Systems"]

[Excerpts] Efficient methods of transportation and travel and attractive connections are of essential importance for our economic growth and for social progress.

The introduction of a new technology in transportation, such as the magnetic rail system, promises, in comparison with existing methods of travel, to have positive effects on the entire economy, on regional and social structures and consequently on the quality of life of the populace. The magnetic rail system, with its noncontact magnetic levitation technology, is opening up interesting possibilities to supplement and expand existing means of travel and is thus contributing to the future security of our transportation system. The following article deals with some important economic and technical aspects of magnetic levitation technology.

1. The system

The introduction of a new technology in transportation, such as, for example, the magnetic rail system, is sensible or even necessary when, compared with existing methods of transportation (railroad, automobile, airplane, inland waterway), the result is a positive effect on the processes of economic development, on the productivity of the entire economy, on regional and social structures and the quality of life of the populace. At the same time, it should not initiate any economic disadvantages for the existing rail systems.

From this the engineers and development staff who research and design the new transportation systems can derive the requirements which, with other considerations, can serve as a definition of the goals in developing a magnetic rail system.

The following important goals can be identified:

- high speeds,
- good "house-to-house" times,
- low dependence on a special form of primary energy,
- high transportation and traffic flow,
- predictability and accuracy in traffic flow,
- high degree of automation,

- extremely low levels of pollution,
- good opportunity for location and small space requirements,
- high measure of safety and comfort for the user,
- reasonable costs and prices,
- combination of passenger and freight traffic (valuable, containerized freight),
- ability to connect with other transportation systems.

A large proportion of these requirements is already met by the specific advantages and characteristics of noncontact magnetic levitation technology. One can point, for example, to the high speed of operation, the low level of environmental pollution in the absence of exhaust gases, to the raised tracks and the high degree of automation.

4. Development

In 1971 Messerschmitt-Boelkow-Blohm successfully tested the first prototype vehicle using magnetic levitation technology and linear propulsion, shown in figure 12. This so-called "Magnetmobil" was the first proof of the feasibility of magnetic levitation technology applied on a larger scale.

A further important step in the development of the magnetic rail system was the proof that electromagnetic levitation technology could function at speeds above 400 km/hour with the experimental vehicle "Komet" in 1976.

A new type of propulsion system used in conjunction with the electromagnetic levitation system demonstrated some advantages; this was the so-called "long-stator magnetic levitation technology," successfully tested by Thyssen-Henschel together with the Technical University of Braunschweig for the first time at a test facility in Kassel in 1974.

The long-stator experimental vehicle with the long-stator components mounted in the guideway is shown in figure 13.

A further important step towards the maturation and application of the magnetic rail system was the successful operation of the demonstration layout for magnetic levitation technology and long-stator propulsion on the occasion of the International Transportation Exhibition in Hamburg in 1979.

This, the first "public" magnetic rail layout in the world certified for passenger operation, was developed, built and operated with the support of the Ministry for Research and Technology (BMFT).

This was the first successful test under operating conditions of the long-stator propulsion system developed by Thyssen Henschel.

During 3 weeks of operation at the exhibition, the magnetic rail train at the IVA 79 [International Transportation Exhibition] carried about 50,000 passengers over a distance of about 900 meters. When checked against the number of trips planned, it achieved an availability and reliability rate of over 99 percent.

The development and employment of the IVA demonstration layout yielded valuable information concerning safety problems, certification questions, routing problems in the inner city and the operational service of a magnetic rail system carrying passengers.

Figures 14 and 15 show some typical situations concerning routing and the employment of the demonstration layout at the IVA 79 in Hamburg.

The demonstration layout in Hamburg was dismantled at the end of 1979 and rebuilt in its entirety on the grounds of the Thyssen Henschel works in Kassel.

Because of the specific dimensions of the grounds the track had to be shortened somewhat. By the end of March 1980, the first section of the IVA vehicle, as figure 16 shows, could be "fed" onto the track.

The magnetic rail system in Kassel--which is the only operational magnetic rail in the FRG certified for passenger operation--is used for parallel testing with the Emsland Transrapid Test Facility, except for demonstration purposes. Besides this, new designs for "magnetic vehicles" are examined and tested using controlled permanent magnets.

5. The Emsland Transrapid Test Facility (TVE)

As a final step from the first realistic application the definition and development of the Emsland Transrapid Test Facility, TVE for short, was begun in 1978.

At this large-scale testing ground, which will be 20.5 km long in its initial stage of construction, components and subsystems undergo preliminary tests in nonstop operation under close-to-operational conditions at 400 km/hour.

The 120-ton test vehicle is powered by a synchronous iron-bound long-stator motor.

The layout selected for the Emsland Transrapid Test Facility is reproduced in figure 17, figure 18 shows a photograph of a model of the experimental vehicle. Development work is already at an advanced stage, vital components and subsystems are close to completion. Construction work on the track and the test center near Lathen has already started.

Preliminary test results should be available in 1983.

6. Application

The Emsland Transrapid Test Facility represents the final step in development prior to the introduction of the magnetic rail system as a means of public transportation. After the tests in Emsland the magnetic rail system will be ready for service.

A first step towards a practical application could be the so-called "interlink," that is, as figure 19 shows, a 50- to 100-km long high-speed line between 2 major traffic junctions, between a city and an airport or even between 2 airports. An interlink line like this could become a reality by the middle of the 1980s.

The real operating target for the magnetic rail system, however, is a high-speed, long-distance, international network, carrying both passengers and freight, that is, routes of up to 2,000 km in length, with an average distance between stops of 150 to 200 km and a maximum speed of over 400 km/hour.

For long-distance traffic in Europe a magnetic rail system, with the advantages and operational possibility described, would be an ideal supplement to the railroad and the airplane.

These distances are too long for present-day trains and too short and therefore uneconomical for airplanes.

Short intervals between trains and mixed passenger-freight traffic are absolutely essential for optimum utilization of the high investment in the lines needed for a magnetic rail system of this kind.

Figure 20 sketches out a possible European high-speed rail system. As long as the development and test applications of the magnetic rail system are pursued with a definite goal in mind, as they have been so far, and if this system can be successfully integrated into a total European transportation plan, it is certainly possible in this century that Europeans will be floating quickly, safely and comfortably across Europe on the first sections of a new long-distance transportation network.



Figure 18. Experimental vehicle of the Emsland Transrapid Test Facility.

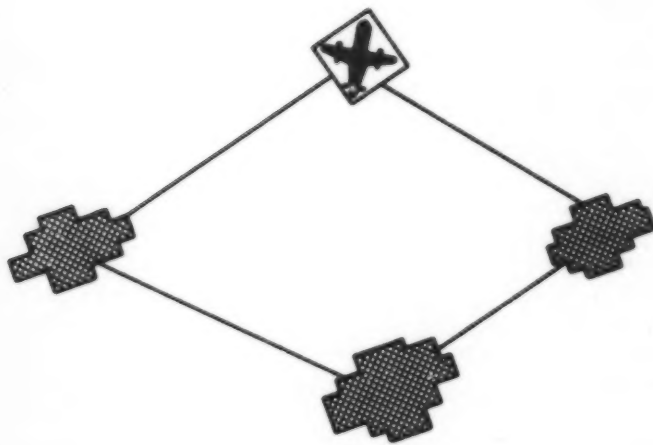
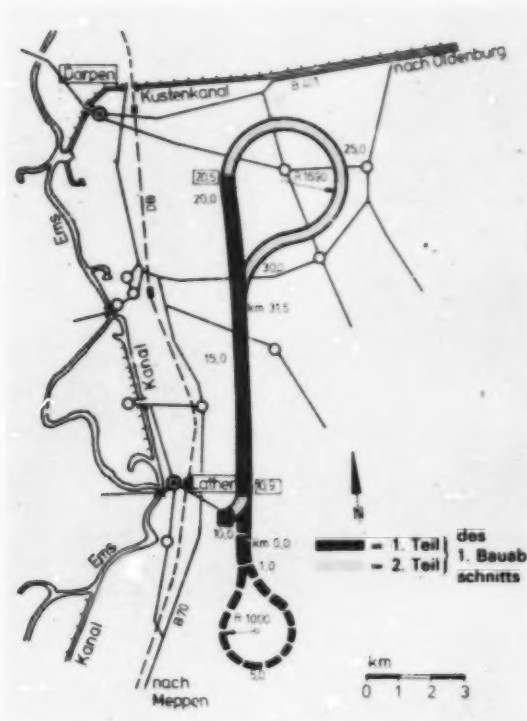


Figure 19. Typical magnetic rail interlink system.



Figure 16. Experimental magnetic rail facility in Kassel (MVK), "feeding" the vehicle onto the track.



1st part of the
2nd part 1st stage of
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Figure 17. Layout of the Emsland Transrapid Test Facility (TVE).



Figure 14. Demonstration layout for magnetic levitation technology and long-stator propulsion at the IVA [International Transportation Exhibition] 79 in Hamburg.

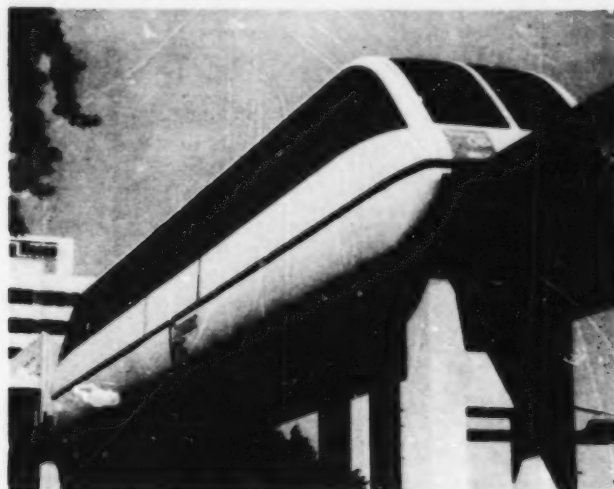


Figure 15. Magnetic levitation vehicle "Transrapid" on the demonstration layout at the IVA 79 in Hamburg.



Figure 12. MBB [Messerschmitt-Boelkow-Blohm] prototype vehicle 1971.

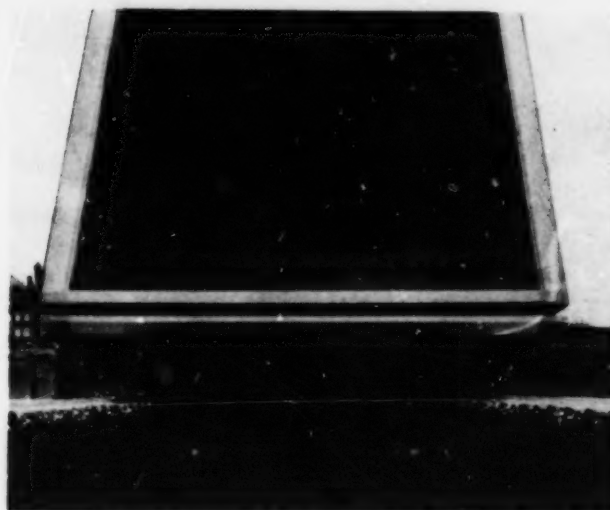


Figure 13. The world's first long-stator test facility at Thyssen Henschel's "New Technologies in Transportation" 1974

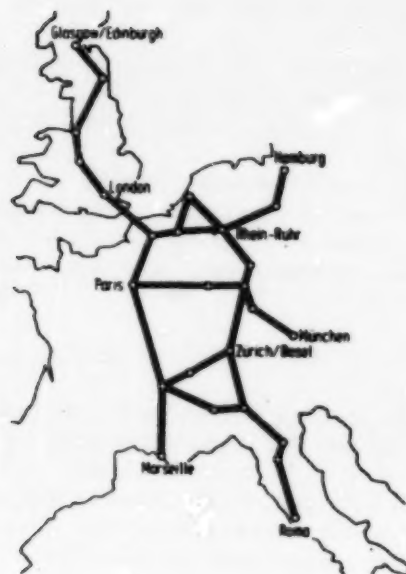


Figure 20. Proposal for a high-speed European magnetic rail system network.

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CSO: 3102/385

TRANSPORTATION

NEW JAGUAR ENGINE SAVES 20 PERCENT FUEL

Duesseldorf VDI-NACHRICHTEN in German 17 Jul 81 p 11

[Article by S. Keretlow: "A Fireball Is Spinning in a Luxury Car Combustion Chamber"]

[Text] Even today outsiders can quite clearly still be pacesetters in technical development--even in such a highly developed industry as the automobile industry. In 1974, the Swiss engineer Dr Michael May, already known then through his ideas about turbochargers ("Turbo May"), developed a new combustion chamber design. He shifted completely away from the idea widespread at the time that the combustion chamber should be as close to a hemisphere as possible (as seen in racing engines for 50 years). May essentially divided the combustion chamber into two levels. There is a shallow depression in front of the exhaust valve, which sits somewhat lower in the cylinder head. The fuel-air mixture is squeezed in during the compression stroke. The shape of the connecting step to the rest of the combustion chamber ensures that the compressed mixture starts to rotate vigorously. The spark plug is located to one side in a corner with less turbulence.

With his "Fireball" design, May was trying to utilize a lean mixture similar to that in a stratified charge engine--but without its complicated construction. The highly turbulent mixture can also tolerate a much higher compression ratio, which increases efficiency and reduces fuel consumption.

As early as 1976 the Swiss engineer showed a suitably modified engine in a VW Dasher to the professional world. Power, fuel consumption and, above all, compression ratio (up to 16:1) were astonishing, but the reaction to the outsider was to wait. Only today are such ideas being discussed, for example, at Opel or VW. The May design does not even require any major changes to the cylinder head, even the parallel overhead valves in widespread use today are eminently suitable. Only the close manufacturing tolerances cause problems. But in a diesel engine they are even closer.

Clearly the British luxury car manufacturer Jaguar has recognized that these ideas can bring about a gain. At Jaguar there is a technically sophisticated, but also extremely "thirsty" engine in the 12-cylinder. It is the first to be equipped with a cylinder head reworked according to the Swiss engineer's patents.

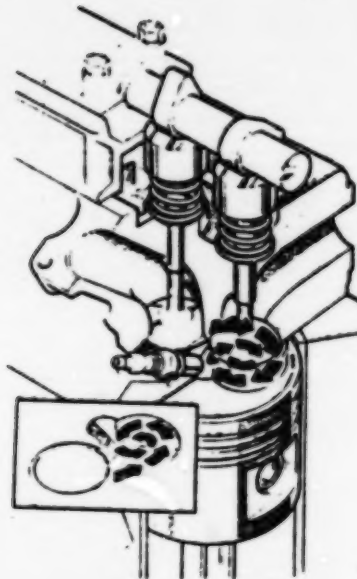
The new engine is called "HE" for short (High Efficiency). Without changing the engine's basic construction (12 cylinders in a 60° V formation) and without a change in capacity (5,345 cm³), the compression ratio was raised to 12.5:1--the highest in

a production engine manufactured today. The digital fuel injection (from Lucas), which the 12-cylinder has had for a year, was calibrated for greater economy but otherwise remained unchanged. There is a new breakerless electronic ignition system which provides extra high energy for ignition with twin coils. Preparations for production of the improved engine required investments of 500,000, or just under DM 2.5 million--an extremely low amount for what has been achieved.

Even in the newest version, the 12-cylinder runs silky-smooth, scarcely audible. Knocking is absent during acceleration, as is running-on when the engine is switched off. Horsepower and torque have also increased: power is now 220 kW at 5,500 revs/min and torque is 432 Nm at 3,000 revs/min. Fuel consumption, the purpose of the exercise, is about 20 percent lower on the average. For the 12-cylinder HE sedan, official British tests certify a fuel consumption of 11 liters/100 kms at 90 kms/hour, compared with 13 liters previously, 13 liters at 120 kms/hour, as opposed to 16 liters, and in the urban cycle, 19 liters compared with 23 liters. For the XJS coupe the figures are about 1 liter lower. With these numbers, Jaguar calculates that it has a lower fuel consumption than its principal competitors, the Mercedes-Benz 500 SEL and 380 SLC.

Along with the installation of the new engine the 12-cylinder model received detail bodywork changes. Equipment is now even more luxurious, the most expensive Daimler versions (technically identical to the Jaguar) even have standard cruise control and air-conditioning. The XJS coupe was given sporty-looking 5-spoke design wheels, new bumpers, a new standard radio and also air-conditioning. A numerically higher rear axle ratio lowers engine revolutions further, also reducing noise and fuel consumption. Jaguar describes the coupe as the fastest automobile in the world with a standard automatic transmission; its maximum speed is 250 km/hour. The sedans, which are among the largest anywhere with a length of 496 cm and a weight of almost 2 tons, are not much slower at 240/km/hour.

German buyers are particularly critical with respect to reliability and quality. Still, of the 16,000 Jaguars built this year (about 3,000 of them with the 12-cylinder engine) 1,500 will find their way onto the FRG market.



Deutlich ist im Schnittbild der „Fireball“-Brennkammer des Jaguars V-12 HE der erzeugte Wirbel während des Verdichtungsaktes zu erkennen. Im Kasten: ein Blick unter das Wirbel-Modell, mit Sicht auf die Ventildeckel.

Bild: Veritas

In the cutaway of the "Fireball" combustion chamber of the Jaguar V-12 HE, the turbulence created during the compression stroke can be seen clearly. Inset: a view from below the turbulence, looking towards the valve heads.

9581

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END

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West Europe Report

SCIENCE AND TECHNOLOGY

No. 78



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BIOTECHNOLOGY

BRIEFS

BIOGAS PLANT SAVES OIL--On the occasion of the opening of the agricultural biogas plant in Ismaning near Munich, Federal Minister von Buelow declared that biogas technology could become much more significant in German agriculture. Even though biogas technology provides only a small portion of the primary energy consumption of the FRG, every contribution to decentralized energy procurement and supply must be welcomed. The new biogas plant is a big plant which cannot be compared to plants that were more or less home-made by the hundreds of thousands (East Asia). A considerably better gas yield can be obtained through the further development of the method, good heat insulation, and heat recovery through storage of followup fermentation gas. The plant in Ismaning has a reaction volume of 1,000 m³ and is thus designed for 1,000 live-weight units of cattle (=1,000 cows). While the daily gas yield in standard biogas plants is 1 m³ per m³ of reaction volume, this plant is expected to achieve an efficiency that will be four times higher. The yield would then attain the caloric value of 2,000 lit of heating oil per day. Besides, the farmers can use the rotted liquid manure as odorless, high-grade natural fertilizer on the fields. While the plant in Ismaning is designed as a central plant for the procurement of biogas, in order to meet the energy requirements of one company, another concept is being carried out in Quickborn (rural kreis of Luechow-Danzenberg) with the help of the BMFT [Federal Ministry of Research and Technology]. An interconnected grid of several smaller biogas plants is being erected there. To the extent that the gas is not used on the spot, it is supplied to a central gas storage tank from which other village inhabitants can be supplied with energy. [Text] [Duesseldorf VDI NACHRICHTEN in German 28 Aug 81 p 4] 5058

CSO: 3102/430

ELECTRONICS

BRIEFS

SIEMENS OFFERS BUBBLE MEMORY--For the Siemens modular microcomputer system SMP, which already comprises more than 70 different module cards using the 100 X 160 millimeter "Europaformat," Siemens announces that there is now magnetic bubble storage, also on Europa cards. Magnetic bubble storage is high-reliability, nonvolatile mass storage, which operates without moving parts and so is completely wearfree. The operating temperature range of 0° to 70° Celsius, which is broad compared with traditional means of storage, enables it to be used in harsh environmental conditions. The magnetic bubble storage system can be expanded in stages from a capacity of 128 kilobits to 1 million kilobits. There are extra switches on the control group to safeguard data in the event of a loss of voltage and provisions for error correction. [Text] [Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 8 Sep 81 p 5] 9581

CSO: 3102/414

ENERGY

REPORT DESCRIBES PRESENT STATE OF NUCLEAR DISTRICT HEATING

Frankfurt/Main FERNWAERME INTERNATIONAL in German No 4, 1981 pp 188-193

[Report by the Unichal "Nuclear Energy" Study Committee, presented at the Unichal Congress in Vienna in 1981]

[Excerpts] The report by the Nuclear Energy Study Commission describes the energy situation, the development, and the current status of nuclear long-distance heat generation in the European countries. It furthermore describes and compares three nuclear heating plant types.

In May 1979, the study commission for nuclear questions on the occasion of the Unichal Congress in Stockholm submitted a report which described the studies and project work done until then on the question of long-distance heat generation in nuclear power plants (1). It presented a comprehensive overview of the on-going planning and basic research in the various Unichal countries.

None of the projects taken up in the report at that time has since then come any closer to practical implementation. The reasons are essentially to be found in the unresolved goal conflicts in the generally prevailing nuclear energy discussion.

Over the past 2 years, oil prices continued to rise drastically and it is to be anticipated that the oil price rise will continue in the future. The growing balance of trade deficits of the oil-importing industrial countries show that it is no longer enough to keep the use of nuclear energy--both for current generation and for long-distance heat supply--open only as an option for the future.

It seems urgently necessary to reduce the consumption of oil and natural gas through the increased use of nuclear energy.

This is also possible in the space heating sector--where the use of heating oil and natural gas predominates in meeting requirements--if long-distance heat supply is further developed and if the possibility of long-distance heat generation with nuclear energy is used.

The report at hand shows the general energy situation and also describes the role of long-distance heat in the European countries. An attempt was then made to describe the current status of nuclear long-distance heat projects in the various countries, so to speak, as a continuation of the last report.

The main point in this year's commission report is a description and comparative consideration of the nuclear heating plants currently undergoing development or ready for offering.

Any consideration on the use of nuclear energy must start with present-day conditions in primary energy utilization. This is why first of all the corresponding statistics for some Western European countries, that is, France, the FRG, Sweden, and Switzerland, were presented. The comparison of the years 1973 and 1979 illustrates the current trend.

It is interesting to note that in the four countries listed, the primary energy consumption, in spite of every effort to save energy, has continued to go up since the first so-called oil crisis in 1973-1974. Primary energy consumption will continue to rise in the future in spite of all attempts to disconnect economic growth from the primary energy consumption--although not to the same extent as in the past. The tie-in factor can be reduced, to be sure, but economic growth today still looks like unrealistic wishful thinking in case of a constant or even a declining primary energy consumption volume.

The use of petroleum of course did not rise any further during the period of time contemplated but in 1979 still covered more than half of the primary energy consumption in each of the four countries. This fact is of grave significance for the raw-material-poor industrial countries because of

The dependence on the oil-exporting countries, especially the OPEC countries and

The extraordinarily heavy burden on the balance of trade which keeps growing due to rising energy prices.

In spite of differing industrialization and motorization degrees, the share of the "household and small-scale consumption" items out of the primary energy consumption of the European countries is between 40 and 50 percent and thus dominant. Because this spread is determined mostly by the heating energy requirements, substitution processes or savings can take effect here in the future. Long-distance heat supply can make an important contribution here.

The description of the scope of long-distance heat supply systems developed so far in the individual countries was prepared in great detail both on the occasion of the IDHC Long-Distance Heat Congress in Fernvaerme and during the World Energy Conference in Munich (2, 3). A comprehensive comparison encounters difficulties because the sources reveal differing presentation methods and reference values.

Available information is given either as a share out of the space heat market, as a share out of the total apartment volume, or as a share out of the number of inhabitants supplied with long-distance heat. It is interesting to note that the development of long-distance heat supply in Denmark, Sweden, and Finland has reached a rather respectable level. In terms of percentages, the FRG is definitely behind the three above-mentioned countries.

An attempt was made--with the help of a comparison of absolute connection figures and heat market shares--to illustrate the conditions here in further detail. The

small long-distance heat supply volume in the FRG here is clearly contrasted against the situation in the Scandinavian countries. We can furthermore tell that the FRG and Sweden meet their heat requirements mostly from thermal power plants while pure heating plant supply systems predominate in Denmark and Finland. In the Eastern European countries, long-distance heat supply on the average is much more highly developed than in the Western European countries.

Considerable differences appear when the connection figure is related to the particular population figures. Even if these specific statistics can be used only for guidance, they do nevertheless clearly show what the differing long-distance heat potential exploration projects in the individual countries look like. In Czechoslovakia, long-distance heat supply accounts for the largest share of the space heat market among all European countries. There, long-distance heat, as in other countries with government-planned economies, has special priority.

The following additional criteria are decisive for the varying conditions of the long-distance heat industry in the individual countries and in addition to climatic and geographic differences:

Energy prices,

Existing built-up area and heating structures,

Electric power industry structures and

Social and general political structures.

Because of the widely differing approaches and conditions in the individual countries with partly government-owned energy industries or planned economies, it would seem that a diverging development, as we compare the countries to each other, will continue also in the near future.

To meet their needs, the Western European countries depend on energy imports to meet much more than half of their energy needs. Only Great Britain and the Netherlands have an opportunity to reduce their dependence—at least for a certain period of time—by means of their own petroleum and natural gas wells (4).

France, Ireland, and Italy must presently import about 80 percent of their primary energy. Belgium, Denmark, and Luxembourg must import between 90 and 99 percent.

The energy imports of those countries consists to a great extent of petroleum. The entire across-the-border worldwide coal trade is presently of minor significance and it seems doubtful whether that will change essentially within the next several years.

Even if oil and gas substitutions, in a short-range and medium-range approach, seem to be of differing significance in the individual countries, the use of nuclear energy for electric current and heat requirement supply would appear to be inevitable for all of them. Nevertheless, the general acceptance of nuclear power plants varies widely in the Western European countries and the other industrial countries.

Industrial development and the maturing of technologies for the peaceful use of nuclear energy were essentially completed already before the first oil price crisis in 1973-74. The expansion plans for nuclear power plants were extensively available and large-scale industrial utilization became worldwide during the sixties. At that time, nuclear power plant planning efforts were tackled quite efficiently; they were further pursued and in some places there were even crash programs.

Here we must mention above all France which, with a need for importing more than 80 percent of its energy requirements, was able to figure out how heavily the resultant difficulties would burden its national economy in the future. In an unparalleled national power effort, France began to carry out its nuclear power plant plans which had been revised upward. France began to build nuclear power plants on the assembly line. At this time, a new power plant is being placed in operation in France roughly every 3 months. The goal is to put 51 nuclear power plants with 53,000 Mw in the grid by the year 1988. By that time, 70 percent of the current will come from nuclear power plants. During the first half of 1980, the figure was already 22 percent. This will clearly reduce the country's present-day dependence on oil and its burden on its foreign-exchange situation.

Switzerland decided on nuclear energy a long time ago because, except for water power, it has no other domestic energy sources. Although it is rather difficult in Switzerland to carry out large-scale technological projects because of the particularly strongly developed democratic rules of the game, nuclear power plants in that country already generate 30 percent of the electric current.

Austria--heavily dependent on energy imports like Switzerland--likewise prepared for the use of nuclear energy. In November 1978, Austria's citizens with a slim majority during a plebiscite voted against commissioning the Zwentendorf Nuclear Power Plant. After that, parliament passed a law banning the use of atomic energy.

Belgium has been using nuclear energy for many years. About one-fifth of the current comes from nuclear power plants. None of the Belgian parties so far have come out fundamentally against the use of nuclear energy.

England--the European country with the longest experience in the peaceful uses of nuclear energy and presently relieved of its momentary energy worries by the petroleum and natural gas discoveries in the North Sea--nevertheless has decided to continue the development of nuclear energy. Starting in 1982, the construction of a new nuclear power plant is to be started every year.

At this time, nuclear energy contributes 12 percent to electric power generation in England. By the middle of the eighties, this share will go up to 20 percent.

Sweden is an example of the way in which excessive politicization of the nuclear energy topic can almost wipe out the fruits of decades of systematic development efforts. In a referendum, the Swedish population decided in favor of the further utilization of existing nuclear power plants and the completion of those already under construction after the government and parliament--similar to what happened in Austria--found themselves unable to act in policy terms in keeping with their mandate.

Spain--whose economy likewise is hard hit by the burdens of large oil imports--presently has two nuclear power plants in operation which contribute 6 percent to power generation. Another six plants are to become operational over the next several years and by 1985 they are supposed to supply already 11 percent of the current from nuclear energy. By 1990, a total of 16 nuclear power plants are to be included in the grid, corresponding to a share of about 40 percent of the total current supply.

In the USSR, as in all countries of the East Bloc, the development of nuclear energy is being pursued in a goal-oriented manner. At this time, about 14,000 Mw of nuclear power plant capacity are in operation and about 25,000 Mw are under construction or on the drawing boards.

The political acceptance of nuclear energy in the FRG extends from unrestricted "yes" via so-called residual requirement supply all the way to absolute rejection. Early in 1981, 10 nuclear power plants provided current for the public grid in the FRG. At this time, 11 nuclear power plants are under construction and another 13 reactors--whose reaction however is far off in the future--have been planned. The current nuclear energy share out of the total current requirement supply comes to about 12 percent. Forecasts regarding specific further expansion efforts are difficult to make because of the prevailing uncertainty in terms of the legal situation involved in the licensing procedures and the partly lacking political decision-making readiness. Nuclear power plant opponents propose the construction of fossil thermal power plants to meet the rising need for power plants. On the other hand, positions have been adopted repeatedly especially in recent times to the effect that the thermal power plant industry cannot be used as an alibi by nuclear power plant opponents.

In the United States, 74 nuclear power plant blocks had an operating license at the end of 1980; 37 blocks had a construction license and another 19 nuclear power plants had been ordered. At this time, the current share from nuclear power plants is about 11 percent and by 1990 the figure is to be 22 percent.

Today Japan is still ahead of France, the USSR, and all other countries and in second place worldwide after the United States when it comes to the use of nuclear energy. The realization of import dependence did not allow a massive protest movement to arise although there are of course opponents of nuclear energy in Japan likewise. At this time, 22 nuclear power plants are already in operation in that country and another 13 are under construction. The share of about 13 percent out of the current generation volume is to be roughly doubled by 1985 and quintupled by 1995.

At the present time, 233 nuclear power plants with about 130,000 Mw are in operation and another 250 with 325,000 Mw are on order in 35 countries.

Considerations concerning the use of nuclear energy for long-distance heating purposes have been entertained in Western and Eastern Europe for quite some time. They were compiled specifically for each country.

Sweden

Sweden in 1956 decided to erect the Agesta Nuclear Thermal Plant near Stockholm in a cavern in the rock. In July 1963, this first thermal power plant, based on nuclear energy, was placed in operation (5).

The thermal output for long-distance heat supply came to 55 Mw and the electrical output was 10 Mw. The plant was a PWR with heavy water as moderator and coolant which made it possible to use natural uranium. The plant was essentially made by Asea and AB Atomenergie. The reactor was closed down for purely economic reasons in 1974.

The Scandinavian countries, Sweden and Finland, for the most part, continued to push the idea of using nuclear energy for long-distance heat (6, 7). In 1967-1970, a long-distance heat supply plan was developed for Stockholm which called for three big nuclear thermal power plants to supply a large long-distance heat network covering the entire urban area. In this connection, the current supply enterprise in Stockholm submitted a request for licensing a thermal power plant running on the basis of a LWR in 1968. The maximum electric output was to be 850 Mw during condensation operations and the maximum long-distance output was to be 1,200 Mw with a pure turbine output counterpressure of 420 Mw in that case. The plant was supposed to be built in Stockholm. It was to be erected as an underground thermal power plant whereby the reactor was to be housed in a rock cavern while the turbine and the auxiliary systems were to be placed in a second separate cavern. It had been planned to install the facility 20-30 m below the surface in the rock, in other words, 10-20 m below sea level. The Swedish reactor safety commission was unable at the end of the sixties to issue a license for the site in the city and the government established a special commission with the job of settling the question as to a nuclear thermal power plant near the city within 2 years. Because of the nuclear controversy, all considerations regarding the construction of new nuclear power plants have been shelved in Sweden for the time being.

Some of the more recent planning efforts in Sweden start with the idea of taking long-distance heat for Sweden from the Forsmark Nuclear Power Plant which is about 120 km from Stockholm. In this connection it would be possible, in addition to the Stockholm metropolitan area, also to supply Uppsala from this system. A heat output of about 2,000 Mw is to be transported over that distance with a maximum lead-in temperature of 165°C.

Similar studies are being pursued to supply Malmö from the Barsebäck Nuclear Power Plant which is about 26 km away. In this way it would also be possible to supply Lund via an approximately 4-km branch line.

Finland

Investigations are also being conducted in Finland to supply the capital with long-distance heat from nuclear energy. A report by the Energy Supply Commission in Helsinki dating back to 1973 notes that supply with electricity and long-distance heat from nuclear energy represents a definitely better solution than the other energy supply alternatives.

A region 40 km west of Helsinki was considered a realistic place for such a plant. A study group established in 1975 was to clear up the technical and economic conditions (8). It has been planned to take a heat output of 1,000 Mw from a nuclear power plant and to transport it over a 40-km transport line with a temperature spread of 160/60°C to Helsinki. The practical implementation of this project however is presently still up in the air.

FRG

The first major studies in the nuclear thermal power sector were started by industry in the FRG with its climatic conditions which are not as good for long-distance heat when compared to the Scandinavian countries. BASF [Baden Aniline and Soda Factory] in Ludwigshafen planned the construction--during the second half of the sixties--of two nuclear power plants on a light-water base with the tapping of process steam (9, 10). Plans called for a system with two PWR with a thermal output of 2,000 Mw which in each case, in addition to an electrical output of 447 Mw, were also supposed to turn out 1,000 t/hr of steam with 18 bar and 265°C. This steam was needed for the production facilities of the chemical plant.

The fundamental planning criteria were as follows:

Double-block design for reliable supply of needed steam output,

Erection of the plant on the terrain of BASF in Ludwigshafen with the idea of having short transportation distances for energy and

Clear separation of nuclear and conventional plants.

Construction was supposed to be started on the plant in 1971 and it was to be commissioned in 1975.

Because of the nuclear energy controversy which developed in the FRG during that time, the authorities first of all demanded explosion protection and later on, in addition, underground construction, and finally construction outside the metropolitan population area. This meant that the enterprise found it practically impossible to build the plant.

Comprehensive investigations for the use of nuclear energy in the sector of long-distance heat supply likewise were carried out during the middle of the seventies in the context of the overall study on long-distance heat as well as the four long-distance heat plan studies which had been worked out for certain regions (11, 12, 13, 14, 15). It turned out that the use of nuclear energy for long-distance heat is not so much a technical but rather above all an economic problem because the tapping of long-distance heat from the nuclear power plants which were planned or built for current generation was and is possible without any special difficulties.

Details on that were reported already in Stockholm. The pertinent literature was compiled in this year's report, specifically, for all of the countries mentioned here.

Switzerland

Switzerland likewise since the middle of the seventies has been looking into the idea of taking heat from nuclear power plants (16). The projects investigated involved the nuclear power plants at Muehleberg, Kaiseraugst, and Beznau and the regions of Bern, Basel, as well as the Aare/Limmattal Region. The projects mentioned however cannot presently be carried out because of the nuclear controversy which also prevails in Switzerland but primarily because there are no developed long-distance heat population areas and thus no considerations regarding economical operations. On the other hand, the supply of a cardboard factory with steam from the Goesgen power plant via an only 2-km pipeline was started in 1979.

France

France has for quite some time been involved in special considerations regarding the construction and use of small nuclear power plants called Thermos which produce heat only for heating purposes without any power-heat tie-in.

A demonstration plant of the Thermos Reactor with a thermal output of 100 Mw is to be erected on the land of the Grenoble Nuclear Studies Center. It is hoped that 20 reactors of this type can be erected in smaller cities in France by the end of this century. This project will be covered in detail in this report.

What conclusions should we now draw from this general situation?

The fuel situation for present-day long-distance heat generation plants in Europe is characterized by the use of fossil fuel. Here we must of course register considerable differences from one region to the next. In France, for example, they use mostly oil for long-distance heat generating plants. In the Netherlands on the other hand they use natural gas whereas in the FRG plants in the power-heat tie-in system are frequently operated with coal whereas thermal plants are mostly operated with oil or natural gas. This situation will hardly change within the next ten years.

Heating oil and natural gas today dominate as fuels in the heat generation sector; together, they account for a share of about 80 percent out of the space heating market in the FRG. The increased use of long-distance heat supply offers the possibility of reducing the consumption of heating oil and gas in this field and in the future to meet the space heating requirements also with nuclear energy.

Although long-term domestic fossil energy sources are available in the USSR, that country nevertheless does have the problem of transporting coal, oil, and natural gas over long distances--something which is a burden on the economic side of energy procurement.

In the Western part of Europe on the other hand--in view of the rising shortage of fossil energy sources, especially oil and later on also natural gas--there arises a need for using the remaining domestic coal and imported coal as raw material for the chemical industry. Because of this task and because of the further goal of generating synthetic natural gas, the coal quantities available for heat generation are considerably reduced. The only way out thus in long-range terms is

nuclear energy. This is why, to meet the space heating requirement, steps will have to be taken toward the utilization of nuclear energy in the not too distant future also in Western Europe.

The introduction of nuclear power plants to relieve the fossil energy market here faces some obstacles.

So far it has not been possible to achieve full acceptance of nuclear energy in all Western European countries. The economy of long-distance heat from nuclear power plants is difficult to implement in Western Europe already because here, due to climatic conditions, the utilization time during the maximum heat load is only 2,500-3,000 hours per year (Eastern Europe 3,500-4,000 hours). This is why it will be necessary to use nuclear energy only for the basic load, that is to say, to meet only about half of the required maximum heat output and thus most of the heat volumes with the help of nuclear energy out of the large total connection potentials.

Because of the hitherto practiced safety velocity, nuclear power plants--which can be converted into nuclear power plants through rebuilding or minor changes--are too far away from the major population concentrations which at the same time represent the big long-distance heat potentials. This results in extraordinarily high investments for the necessary transport line for long-distance heat in the case of such projects and those investments so far have seriously threatened the economy or at least the financiability. As fossil fuel prices keep rising, heat transport over long distances will also become economically justifiable to the extent that the corresponding population concentration areas with a high thermal potential have already been opened up in a decentralized fashion in terms of long-distance heat supply.

Regardless of that it will be necessary to erect thermal plants operated with nuclear energy which, because of their small threat potential, can also be built in the immediate vicinity of cities or even in the cities themselves. This will become necessary especially where small cities are to be supplied with long-distance heat but are to be independent of fossil energy sources.

The accent in this report was placed on the technical description of three thermal power plant reactor types, that is, Thermos in France, Secure as the joint Swedish-Finnish development and the AST-500 in the USSR (24, 25, 26, 27, 28).

For a detailed description of these projects, we would like to refer to the report itself. At this point we will only indicate the major differences among the three concepts.

1. Heat Output and Lead-In Temperature

The design output of the reactors was influenced by the development status of the long-distance heat networks in the individual countries and by the long-term goals in national long-distance heat development. Moreover, market studies were conducted as to the possibility of using nuclear power plants in population concentrations that would be suitable for long-distance heat supply in an effort to select the design output.

The determination of the temperatures at the outlet of the nuclear power plant depended on the lead-in temperatures of the connected long-distance heat network. These lead-in temperatures were determined at the start of the network buildup and they may vary from one network to the next.

2. Core Cooling

In the case of Thermos and Secure, the core is cooled during standard operations through a forced circuit whereas in the case of the AST-500 it has a natural circuit [cycle]. The core cooling especially in the case of Thermos essentially corresponds to a system used in the big PWR.

3. Output Regulation and Emergency Shutoff

In the case of Secure, the output is regulated through a change in the reactivity of the moderator by supplying boric acid for fresh water. Boron-water is feed into the primary cooling cycle for the reactor's emergency shutdown. The reactor's long-term shutdown is accomplished through boron-containing steel balls which are introduced into the core.

The output at Thermos is regulated in the case of the big PWR by running the absorber rods in; their drives are arranged below the reactor pressure vessel. The regulator drives [motors] are supplied with power from a redundant power grid. The emergency shutdown can be accomplished both automatically by inserting the regulating or safety rods or also manually. In the case of the manually-controlled emergency shutdown, a neutron poison is fed into the reactor basin and into the primary cooling cycle.

The output regulation at the AST-500 is accomplished by changing the mass current [slow] in the medium cycle. This produces a change in the steam portion in the primary cooling cycle and thus a change in the reactivity of the moderator. For emergency shutdown, absorber rods are inserted into the core from the top. Compared to the design in the case of the Thermos, this does not require any connecting charges in the flooded area of the reactor vessel.

4. Safety Concepts

The average fuel output is important in reactor safety because it determines the danger of the release of waste products. It has turned out that the AST-500, with 10 kw/kg of uranium, has the least average fuel output. The corresponding figure for Thermos is 32 kw/kg of uranium, in other words, more than three times as much. The average fuel output of Secure is 15 kw/kg of uranium and thus is more than that of the AST-500 but definitely less than that of Thermos.

The separation of the primary cooling cycle from the basin by means of gas bubbles is a special feature of Secure. This system represents a safer device for fast reactor shutdown. The functional effectiveness of this system among other things was proven in a demonstration model. The extent to which the results of the theoretical investigations and experiments can be transposed to a big plant cannot be judged.

The entire primary cooling cycle, including the heat exchanger for the intermediate cycle, is integrated into the reactor pressure vessel in the case of the AST-500 and Thermos. Compared to the Secure design--where the revolution pumps of the primary cooling cycle and the heat exchangers to the intermediate cycle were placed outside the safety enclosure--the integrated arrangement for Thermos and AST-500 represents a safe barrier.

On the basis of available information it is impossible to make any statements regarding differences in the release of radioactivity both during normal operation and in case of assumed trouble.

5. Plant Investments

The documentation available to the commission also contained initial data on plant investments. The manufacturers had submitted specific offers for Thermos. These amounts thus represent a realistic figure at this point in time (29).

On the other hand, one must consider the data for Secure as a very recent estimate without any consideration of the requirements connected with a specific site.

No prices based on cost are available for plant investments connected with an AST-500 (30).

Without considering these reservations, the comparison shows that Thermos reveals the highest specific investment for Grenoble. On the one hand, this is a consequence of the degree of implementation of the project whereas on the other hand the cost decline begins to make itself felt already in connection with output figures between 100 and 500 Mw.

We cannot say to what extent other parameters influenced the investments without a detailed breakdown of the investment amounts in accordance with the individual structural components.

By way of summary one can judge the three concepts as follows:

In the Thermos and AST-500 systems, feasible concepts were implemented on a short-term basis. Both reactor types reveal essential characteristics of the reactors which are operated commercially in France and the Soviet Union. On the other hand, simple, new systems were deliberately developed for many important components in the case of Secure.

Otherwise, the three plant concepts--using the basin reactor, the "cold core," and the three cooling cycles--represent the practical expression of the safety requirements which are necessarily high when such plants are placed near cities.

In conclusion we can say, regarding the significance of the heat reactors for future long-distance heat generation, that prices for fossil primary energy will in the future presumably continue to rise more than prices for capital goods. There will be an increasing demand for replacing primary energy with capital. Central long-distance heat supply, using the power-heat tie-in, will make it possible to materialize this requirement for the space heating sector. The economic advantages of

nuclear long-distance heat generation should be used in the future for the supply of long-distance heat at reasonable cost.

These advantages consist in the following:

Lower heat production costs coupled with a greater output from the generating plant. This is a consequence of the cost decline which is particularly effective in connection with nuclear plants. The reason for this is to be found in the large share of fixed costs and the lower share of fuel costs compared to fossil-fired thermal power plants;

Greater independence of the long-term development of energy prices. First of all, the small share of fuel costs has a positive effect on the heat production costs. Besides, it is advantageous that one uranium charge will suffice for a period of several years.

When taking long-distance heat from large power plants, the main problems are heavy investments for transport lines as well as the absence of extensive long-distance heat networks with sufficiently large connecting output figures. This is why the following requirements above all apply to economically justifiable nuclear long-distance heat generation at this time:

Placement of production plants near the city,

Generation of basic load and

High degree of safety during all operating states.

The reactors described represent a justifiable concept for meeting these requirements.

Nuclear thermal plant manufacturers should standardize such systems so that the licensing procedure for the erection of structurally identical plants can be simplified.

The heat output should practicably be so dimensioned that nuclear thermal plants can meet the basic load requirements. But the advantages of the cost decline should not be disregarded here.

Differing optimum heat output figures will result from these requirements for nuclear thermal plants in the individual countries.

In order to facilitate the production of adequately large numbers, it will be necessary to expand the long-distance heat networks briskly so that they will reach the required connection output figures.

Close cooperation will be necessary in the future between long-distance heat operators, the reactor makers, and policymakers to coordinate these developments.

It is the task of the policymakers to create the general conditions for the rapid development of long-distance heat systems. Because of the heavy financial advance

payments, it will be necessary to work out possibilities of reducing the start-up losses and accordingly it will be necessary to include funds in the planning of the budgets for these projects. The positive contributions from comprehensive investments in the long-distance heat sector to the employment situation must also be considered here.

Because of the great advantages to the national economy deriving from the use of nuclear thermal plants in the space heating sector, such as the reduction of the foreign-exchange outflow for the import of primary energy, improved utilization of capacities in the nuclear industry, as well as safety regarding fuel supply in the long-distance heat sector, policymakers are called upon to arouse an understanding for the necessary use of nuclear energy, for example, in thermal reactors among the population.

Regarding the issue of site designation, the policymakers must also consider the positive effects of nuclear energy utilization especially regarding an immission situation in population concentration areas which today are heavily polluted.

The Grenoble demonstration project will be trend-setting for further development of long-distance heat generation by means of thermonuclear power plants.

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ENERGY

POTENTIAL FOR USE OF REGENERATIVE ENERGIES IN FRG

Frankfurt/Main ELEKTRIZITAETSWIRTSCHAFT in German 25 May 81 pp 378-381

[Article by Graduate Engineer Joachim Nitschke, staff employee at the Association of German Electricity Works, e.V. (VDEW), Frankfurt (Main), and Dr of Engineering W. Piller, staff employee at the Isar Ampferwerke AG, Munich: "Thoughts on the Use of Regenerative Energy Sources and Numerical Values on Their Possible Future Share in the Primary Energy Demand in the FRG"]

[Text] It is a legitimate desire to want to use regenerative energy sources for meeting our energy needs instead of limited raw materials, even if in some cases these are sufficient to last hundreds of years. On the basis of the literature, the authors present the theoretical potentials of the various regenerative energy sources for the world and the FRG. The secondary energies which can be generated with them, the technical problems of their utilization, as well as the environmental questions which arise are compiled and presented in a table. An optimistic assessment points to the possibility that in the year 2000 some 8 to 9 percent of the FRG's primary energy demand may be met by regenerative energy sources.

The complex of questions involved in the expression "energy supply" is in the limelight worldwide as one of the greatest problems of our times.

Of course, this applies especially to a country as highly industrialized as the FRG is, whose "to be or not to be" in the world market as well as its private-sector standard of living at home, among other things, is closely connected to an adequate and assured supply of energy. Thus it is not surprising that in addition to the experts, who have been occupied for a long time with this body of subjects, by now broad circles of the general population have also begun to concern themselves with questions of energy supply. This awakening energy awareness, which is absolutely essential and should even be encouraged further, is a positive feature--but with a portion of the population it is overshadowed by strongly emotional views in the absence of adequate factual knowledge and by reason of one-sided information.

Meanwhile this field, which from the nature of the subject is very complex and difficult, is all too frequently simplified unduly. Especially in connection

with catchphrases such as "soft technology," untenable patent remedies based on regenerative energy sources are frequently offered. Not seldom this goes hand in hand with a condemnation of the technology being practiced--something which is not helpful in the examination of the burning questions of energy supply, but rather is only detrimental to this and, moreover, often adds an emotional charge in advance to suitable solutions and concepts.

Certainly the present article cannot provide a solution for this state of affairs, but we hope that it may help to objectify the discussion and put it on the basis of largely certain facts. Table 1 shows briefly to what extent the regenerative energy sources--which again and again are the rallying points for a group of "energy debaters," who unfortunately are strongly polarized today--could contribute to the FRG's primary energy supply in the year 2000.

In this area it is less a matter of absolutely precise numerical data--nobody is able to provide that--than it is a question of the order of magnitude of such contributions.

From the wealth of proposals in the literature concerning regenerative energy sources and their possibilities for utilization (1 to 16), Table 1 sifts out a short extract which gives a general idea of the potentials and possibilities for using regenerative energy sources in the FRG. At the same time the table contains those quantities and facts each mentioned repeatedly by several authors--gleaned from an overall survey of the literature, which is often contradictory.

In a largely self-explanatory way, Table 1 shows the respective regenerative energy source in column 1, in column 2 presents the theoretical energy potentials, subdivided into values for the world and the FRG, then in the following columns gives an indication of the average power densities to be expected and continues with the data on the secondary energy which is to be generated and an indication of the type of system in each case which is needed for energy conversion. Finally, following some remarks on technical problems and cost estimates according to the present state of the art with regard to the conceivable developmental potential, as well as the complex of environmental questions from the viewpoint of the FRG, the survey is rounded out by an indication of feasible prospects of application as well as the absolute contributions to be expected of the individual regenerative energy sources, in TWh/a [terrawatt-hours/year], for the meeting of our energy needs for the year 2000.

Moreover, from this last column one can derive an overall potential from regenerative energy sources of 352 TWh/a in the year 2000 for the FRG. If one sets this sum at 100 percent and considers the individual contributions by the various regenerative energy sources, he finds that the biggest contribution, of 210 TWh/a, is expected from the sector of environmental heat. In second place, with a share of about 85 TWh/a, equivalent to 24 percent, is the potential from water power, with inland waters being especially important here.

It should be noted further that of the technically utilizable potential of water power, today already more than 60 percent is being used in running-water

and stored-water power plants, which clearly refutes, by the way, the widely current impression that using regenerative energy sources is a discovery of our own days. Rather it is no doubt the case that every energy source for which appropriate technical systems and equipment for energy conversion had been developed and were available has always been and is being used with due regard to the costs connected with its utilization.

Finally, solar radiation is able to furnish an estimated contribution of 33 TWh/a ($\pm$ 9 percent), and on the basis of the above-mentioned assessment we get a maximum of 24 TWh/a for wind energy, corresponding to 7 percent of the total expected energy supply from regenerative energy sources in the year 2000. The other regenerative energy sources described in Table 1 can scarcely make any noteworthy contributions from what we can see today--and in this connection, within the remaining 19 years of our century it is highly certain that no revolutionary innovations can be expected.

When the primary energy demand for the year 2000 in the FRG, which is estimated at 4,150 TWh/a [16], is given the value of 100 percent, the sum of the maximum estimated values from regenerative energy sources is equivalent to a share of 8 to 9 percent.

This percentage, which is based on predictive data arrived at through definitely optimistic assumptions, makes an unequivocal statement about the expectations which can be placed in the potential from regenerative energy sources. Moreover, it makes plain that even the discrepancies in the absolute contributions made by individual regenerative energy sources as found in the values indicated by the various authors--discrepancies which a study of the literature data shows to be quite large in some cases--cannot change decisively the picture with respect to the order of magnitude of the contribution to the expected primary energy demand.

The relatively small contribution of regenerative energies to meeting the primary energy demand should not lead us to neglect developments on the utilization of these energy sources. Even small amounts reduce the additional demand for non-renewable primary energies--especially in the developing countries. But the figures show that the expansion of conventional energy structures, including nuclear power, must not be neglected under any circumstances.

To pursue the line of thought further on this score, let us just consider by way of example the largely still unutilized potential of environmental heat--which is probably still the most promising regenerative energy source for the FRG. The heat pump is of decisive importance for its utilization. But the heat pump needs additional energy for its driving mechanism. According to the present state of the art, this can be supplied in the form of oil, gas, or electricity. But because of the absolute maxim that other sources must be substituted for oil, this fuel is likely to be largely out of the picture.

Thus we are left with gas and electricity. Here, according to the present state of the art gas is important mainly for systems with large heat pumps, whereas the major portion of utilizable environmental heat in the domain of supplying space heating to the household [16] is likely to have a need for small electrically operated heat pumps. Since only in the rarest of cases will these systems be

likely to replace heating plants which run on electricity as a secondary energy source, but probably for the most part will be substitutes for existing oil-fired plants, and moreover since in the future as well there will continue to be a demand for new heating plants, for this field of application alone one can expect an additional demand for electricity. Moreover, in our present line of thought let us not even go into the hotly debated question of output--whether or not in the future substantially increased power-plant capacity will be necessary--but let us merely state that "work" in the form of electric energy must be made available as cheaply as possible.

This is true in any case if one wants to achieve the ambitious goals of exploiting the potentials from regenerative energy sources in accordance with the last column of Table 1. Thus there can be no conflict and no competition between on the one hand regenerative energy sources together with their relevant technologies, and on the other such technologies for the transformation of fossil and nuclear raw materials, but only a close and sensible "cooperation-mutual support."

Although in our considerations up to now we have not touched at all on questions such as "capital substituting for energy"--certainly a serious economic and business-management problem--or on the great range of technical tasks of development and improvement still to be clarified and performed in connection with devices for the utilization of regenerative energy sources--let us at least draw attention to one point more. Not only the development for mass production of devices for utilizing regenerative energy sources, but also the requisite expansion and redesigning of conventional energy-generating and distributing facilities requires considerable periods of time. Therefore, if we want to achieve the goals aspired to in reducing our dependence on imports in the energy sector, a clear stand should be taken on all technologies necessary for these goals, and among these are also the technologies of the energy transformation of fossil and nuclear-energy raw materials--so that we do not have to come to the realization later that we have run out of time.

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Table 1. Regenerative Energy Sources, Their Potentials and Utilization Possibilities in the FRG

Regenerative energy source		Theoretical potentials ¹⁾		Average power density for FRG	Secondary energy	Type of system
		World	FRG			
Solar radiation		1.55×10^9 TWh/a	250×10^3 TWh/a	With a maximum of 1,600-2,000 h/a [hours/year] of sunshine, average values of 100 W/m^2 ^{2 4)}	Electric energy	Photovoltaic power generation
						Solar-thermal power generation
				Marked fluctuations; time of year, day/night, degree of cloudiness, orientation of the receiving surface, and so forth	Thermal energy	Flat collectors for warm water, possibly heating
					Chemical energy	Forced photolysis
WATER POWER	(Inland waters)	44×10^3 TWh/a	110 TWh/a ³⁾ of which more than 60% already being high used	Variable, generally	Electric energy	Running-water power plants
	Waves			14 kW/m of wave front (average North Sea wave)	Electric energy	Stored-water power plants
						For example, water turbine in pipe, $\varnothing$ pipe 5 m, wave height 1 m = 50 kW
		8×10^6 TWh/a				
	Current			Slight	Electric energy	Water turbines
(Sea)	Tides	26×10^3 TWh/a		Tidal amplitude of $\varnothing$ 3 m too small along German North Sea coast	Electric energy	Storage pool with water turbines
	Ocean heat	3×10^3 TWh/a	Not utilizable	Small, at least 20 K temperature gradient necessary	Electric energy	Floating power plants with refrigerants
	Wind energy	30×10^6 TWh/a	220 TWh/a	About 30 W/m^2 of rotor area subjected to wind flow	Electric energy	Wind-energy systems (rotors)
Environmental heat	Soil					
	Water					
	Waste heat				Thermal energy	Heat pumps
	Air					

Regenerative energy source	Theoretical potentials		Average power density for FRG	Secondary energy	Type of system
	World	FRG ¹⁾			
Geothermal energy	80x10 ³ TWh/a	138 TWh/a	63 kW/km ² , technically utilisable only with geological abnormalities, since then power density is higher	Electric energy	Steam power plants
				Thermal energy	Warm water for heating purposes
Biomass	1.5x10 ⁶ TWh/a		With soil utilization, about 1 kWh/m ² a	Electric and/or thermal energy	Energy-plantation processing--conventional power plant
Glacial ice		Not utilisable		Electric energy	

1) FRG - Federal Republic of Germany including West Berlin

2) Comparison with energy produced per year by 1,300-MW nuclear power-plant unit

3) Electricity converted into primary energy demand for thermal generation

4) Annual average values

5) Electrical power

6) Thermal power

Technical problems	Expenditure	Environmental questions	Prospects for applications and possible contributions from regenerative energy sources ³⁾ for FRG in the year 2000	TWh/a	t
Poor efficiency of solar cells (4 to 16%)	100 to 1000 DM/W ⁴⁾	Area-intensive: 1,300 MW ⁵⁾ needs about 13 km x 13 km ²⁾	Only for special applications (broadcasting stations, etc.). Studies: Satellite Solar Power Station	<<	
Use of mirror systems, efficiency small (max 10%)	About 1000 DM/m ² very high	Area-intensive	Only for special applications (testing stage, pilot projects)	<<	
Discontinuous output, storage problems, pollution, durability	High, 100 to 500 DM/m ²	High area requirement	Increasingly used-- especially for dwellings and swimming pools (reservoirs)	33	9
So far, only laboratory tests	--	--	--	--	--
Geological difficulties with increasing expansion	High	Few problems	Often economically justifiable only in conjunction with expansion of waterways	85 ³⁾	24
	High	Establishment of artificial lakes	River control		
Storage, power transfer, life-time of the systems		Possible obstruction of shipping and fishing, large facilities can decrease water circulation	Applications for special purposes, for example light buoys, otherwise presumably slight	<<	
Large propellers; electricity transfer		With large facilities, restriction of currents, shipping!	Very slight	<<	
Tidal amplitude, construction of the storage pools	If 3 m of tidal amplitude utilizable, an embankment dam along the German North Sea coast from Norderney past Helgoland and Sylt would meet about 8% of the present electricity demand in FRG		Very slight	<<	
With respect to output, very large facilities, power transfer	High	Possible climatic consequences (Gulf Stream)	Not utilizable	--	
Small power density, storage, durability	About 5,000 to 12,000 DM per kilowatt	Area-intensive: 1,300 MW require 2 x 40 km with wind wheels 185 m high	Partially utilizable	24	7
Improvement of efficiency of use or coefficient of work/year a	a = 3 to 3.5 a = 3 to 3.2 a = 2 to 4 a = 2 to 2.5	With large-scale use, possibly micro climatic effects Additional power demand	Assured use	210	60

Economical fields of application already exist

Technical problems	Expenditure	Environmental questions	Prospects for applications and possible contributions from regenerative energy sources ³⁾ for FRG in the year 2000	TWh/a %
Continual magmatic changes in the subsoil; often contamination of the steam or water; locating of the abnormalities; recovery; distribution	Given a theoretical utilization of the earth's heat at a depth between 4 and 6 km over the entire surface of the FRG, only about 10% of the present electricity demand in FRG could be met		No assured prospects Slight	- <
High energy expenditure for harvesting and processing	About 22,000 km ² for 1,300 MW ⁵⁾ = 8% of the area of FRG	One-crop system, world food problems	Only for special cases, very slight	<<
			Not utilizable	--
				<u>352 100%</u>
Primary energy demand		World 1979: 75 x 10 ³ TWh/a World 2000: 122 x 10 ³ TWh/a		
		FRG 1980: 3,183 TWh/a FRG 2000: 4,150 TWh/a	<u>8.5% based on 4,150 TWh/a</u>	

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ENERGY

FRG-BELGIUM COAL GASIFICATION EXPERIMENT BEGINS IN FALL

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 11 Sep 81, p 7

[Text] Frankfurt, 10 September. This autumn, below-ground coal gasification for the purpose of obtaining gas from an "intact" coal seam in Belgium will begin. The experiment is being conducted as a joint project between the FRG and Belgium within the context of an agreement signed in 1978. In its present, first phase, gas with a low caloric content is to be obtained; starting with the coming year, "richer" gas is to be obtained. This coal mining operation without a miner in the form of gas could considerably improve the energy situation of the coal-rich countries.

This kind of below-ground gasification has already been used in the Soviet Union for decades and it is currently being tested in the United States. The Soviet gas-supplying coal fields (the first one was placed in operation in Angren in the Donets basin) are a model for further developments in the rest of the world and they gasify coal through below-ground combustion. Air is injected into the borehole and it ignites the coal seam whereby most of the coal is gasified without burning on account of the throttled air supply. The gases are suctioned off and used by means of a second borehole which is about 20-30 m away. A connecting duct must first be made for the control of the gasification process between the two boreholes at the foot of the seam to be burned. This is done by means of "back-combustion" from the subsequent suction evacuation borehole.

The experimental fields in the United States, such as "Hanna," "Hoe Creek," and "Princetown," are also using this method. Gasification becomes somewhat more complicated in seams that are very steep, that extend to the earth's surface, and that in most cases contain much moisture or get moisture from adjacent rocks. The evaporation of this water requires a decisive share of the heat energy generated by coal gasification, that is to say, it causes heavy energy losses.

This water content also caused the failure of a project for coal gasification in Morocco during the early fifties. A coal seam was gasified there and it likewise was positioned in a very steep manner and contained much water. The gasification front was laid out only at a depth of 50 m. In the process, a gas with a combustion value of only 1,450 kJ per cubic meter was produced and, on the average, only 30 percent of the caloric energy of the gasified coal were obtained, partly because

of the moistness of the coal and its neighboring rock and partly because a portion of the gas obtained (gases and possibly also the injected air) was lost due to cracks and fissures in the bedrock.

This experiment at Djerada in Morocco was then abandoned very soon. But it provided interesting operating data which were used at the start of the planning for a Western European experiment on below-ground coal gasification in order to calculate the potential of such a "coal-seam gas field" under better operating conditions in theoretical terms. Accordingly, the same coal field, if it had been at a depth of 700 m, with "dry" coal and "sealed" against the surface, under identical operating conditions, would have yielded a gas with double the caloric content. If the air had been injected with higher pressure, the caloric content of the gas would have been three times higher. In the first case, the coal would have been used to the extent of 53 percent and in the second case to the extent of 70 percent.

These data and the other experiences became the guidelines for the West German-Belgian joint experiment on coal gasification adopted for the year 1978, an experiment which had been underway in Belgium in 1979 in the region around Thulin. At the edge of the Borinage coal basin there, we have a zone with coal seams which had never been mined before because they are subjected to very strong "orogenic disturbances"; this region is particularly suitable for coal gasification below ground above all in the experimental stage because the seams and the neighboring rock have not been "disturbed" as a result of mining and therefore are particularly well sealed against the surface.

In the GLUECKAUF-FORSCHUNGSHEFTE the leader of the German-Belgian "Project Group for Experiments on 'In-Situ Gasification' of Coal," Pierre Ledent, Liege, recently reported on the problems and the development status of the project. In his report, Ledent points out that "below-ground working of our deep deposits is an outdated method of energy procurement which is no longer in keeping with the living standard of our people." That was not recognized about 30 years ago when the big economic expansion began in Western Europe and the technology of obtaining coal energy "without miners" through below-ground gasification, which was developing at that time, was not further advanced. Now that Europe has become clearly energy-dependent as a result of the oil crisis--a condition which cannot be adequately terminated by using coal because of the tremendous wage costs--underground gasification could be an answer to Europe's problems. By the end of this century it could experience an upswing similar to the one which coal mining achieved at the start of the last century.

The beginning toward this new technology in this experimental undertaking between two countries of course is still being made by using the technology available at the start of the fifties, something which was developed above all in the Soviet Union; the idea is to start underground gasification by burning the coal seams off from boreholes, specifically after building a connecting duct through "backfire burning" between two boreholes. There is also the intention first of all to start with small "gas mining fields"--that is to say, with boreholes at a small interval of about 35 m. The decisive difference between the West German-Belgian experiments and past experiments aimed at achievement in underground gasification consists in the fact that very deep seams are to be gasified in Thulin. They are located between 800 and 900 m. Of course, this kind of gasification at great depths also calls for a much greater expenditure for the drilling of boreholes which furthermore must be dug very accurately "aimed" into the depth in order to

achieve the right intervals at the foot of the borehole and thus to get the correct experimental results.

This experiment in the meantime has advanced to the point where the planned four deep drilling operations are ready so that the coal for backfire combustion (that is to say, the gas pipeline duct at the bottom of the seam) can be set on fire; this is supposed to be done very shortly, presumably this autumn. After the completion of the connecting ducts, the engineers will first of all start with gasification on a larger scale, the idea being to work with air injection. When the coal seams are that far down and when the coal is dry, it is necessary to add some water vapor to the air in order, during gasification through partial combustion, to get the desired product, a "synthesis gas" consisting of carbon monoxide and hydrogen.

It is expected that the seam, "thus stripped of its coal," will gradually be filled as the "covering rock" sinks down from above--something which creates the possibility of orogenic damage. But the rocks above the seam must first sink down so that the seam to be gasified will remain constantly sealed. The superposed rock formation may sink only "plastically" and not in a "fractured" fashion if density is to be guaranteed. Besides, this energy procurement method is likewise tainted by an environmental problem: One cannot rule out the possibility that small quantities of carbon monoxide might rise to the earth's surface from the seam to be gasified. Thus it is necessary to conduct experiments with seams which are located under an area that is not inhabited.

The current experiments of course are only supposed to be a first phase in this joint experiment. It is hoped that it will be possible to go on to the next phase already next year, when the area of the gas mining fields is to be expanded by using boreholes with far greater intervals (50-70 m) for gasification so as to improve the exploitation of the expensive drilling operations considerably. Besides, the idea is then to work with oxygen plus steam as gasification agent, instead of working with air plus steam, in order to avoid burdening the gasification method with the 80 percent nitrogen which are added to the air. This nitrogen is dragged along during the entire reaction; it must be forced through the pores of the hard coal under pressure and it drags unused caloric energy away.

5058

CSO: 3102/430

ENERGY

OFFICIAL DANISH TEST SITE FOR COMMERCIAL WIND POWER PLANTS

Stockholm NY TEKNIK in Swedish 30 Jul 81 p 4

[Article by Karl G. Jonsson]

[Text] There is presently a rush for small wind power plants in Denmark. Several manufacturers have orders for over 100 plants. New designs are coming out constantly.

The Riso research station holds a key position in Denmark's wind power program. The station is the official test site for wind mills.

The Riso test facility on the Roskilde Fjord has everything from nuclear power technology to agricultural research. Two years ago the Testing Station for Small Wind Mills was opened.

In the beginning an engineer and a mechanic were employed. Now Per Lundsager has 10 workers under him and before the end of the year that figure may almost double.

Testing and Advice

The testing station is active in four areas: Free advice is given to manufacturers, purchasers, and authorities. The manufacturers must construct the wind power plant themselves for testing on the "test track" at Riso. Further, systems evaluations are made for the type approval required for state funds. Finally, research and development are carried out--a task that so far has suffered because of the assault from outside.

Because of the enthusiasm for wind power in Denmark engineers at Riso have seen all imaginable--and some unimaginable--models at the test site, from the small Darrieus wind mill from the technical university to the so-called Ulril Poulsen mill which attempts to avoid using a high and expensive support by mounting the rotor on a long axle slanting up into the wind.

"There are still some manufacturers who do not understand that you get nothing free," Per Lundsager said. "What they gain in simplicity, they lose in efficiency."

So far over 40 applications for type approval have come in and 34 models have been approved.

A "wind atlas" has been developed on Riso which calculates the annual production of electric power for a given model at a given location within a 5 to 10 percent margin of error.

Agricultural Buyers

Most investors in wind power today are farmers or gardeners.

The Energy Ministry contributes 20,000 kronor toward the purchase of each wind power plant with type approval from Riso.

"The calculated lifetime is 25 years," Per Lundsager said, "but at present we are only guessing."

"Our analyses indicate that regardless of what one purchases, energy price rises are the deciding factor. Most often the windmills are profitable after just a few years and experimental windmills built 4 or 5 years ago are already yielding large profits.



Test site for wind power plants at the Riso research station in Denmark. All imaginable--and some unimaginable--models may be seen here.

ENERGY

BRIEFS

EC SUBSIDIZES COAL RESEARCH--The EC has made available a total of DM 40 million for 36 programs designed to improve mining technology and to promote the development of coal refinement. On the average, 60 percent of the project costs will thus be taken care of. The FRG gets 12 projects with an allocation of DM 15.6 million. Among other things, the idea is to promote the development of new methods for coal liquefaction; this is being pursued by "Mining Research, Incorporated" in Essen-Kray in cooperation with several college institutes. The EC Commission participates with DM 2.3 million in the costs which total DM 3.8 million. Results from the program, which has been underway since the beginning of this year, are to be available at the end of 1982. [Text] [Duesseldorf EUROPA CHEMIE in German No 22, 1981, p 369] 5058

CSO: 3102/418

INDUSTRIAL TECHNOLOGY

STEEL INDUSTRY GETS MAJOR FACELIFT WITH GOVERNMENT FUNDS

Stockholm NY TEKNIK in Swedish 30 Jul 81 pp 8-9

[Article by Harald Gatu]

[Text] Domnarvet is changing. With investments of 1.5 billion kronor, SSAB (State Steel Corp.) will make Domnarvet a leading producer of thin sheet metal. With new Japanese technology, the sheet will be used extensively in the automobile industry, which imports most of its thin sheet at present.

The change has another side, however, and another price: Domnarvet is losing about 2,000 jobs and the unemployment line in Borlange will become longer and longer.

The new Domnarvet will be complete early next year.

During the vacation weeks Domnarvet's steel mill is normally ghostly silent. This summer the picture was different: about 600 contractors, along with Italian, Japanese, and West German experts, were rushing to finish the expansion of Domnarvet's band and thin sheet production lines.

Almost half of the just over 3 billion kronor invested by the state in SSAB has gone to the Band 82 project which will make Domnarvet one of the leading producers of thin sheet in Europe.

At the same time, Domnarvet has lost over 1,000 jobs and almost as many, 800, will be lost in December of next year. Domnarvet has provided jobs for as many as 6,200 workers. The goal is to reduce the number of employees to 4,400.

"We can possibly reduce this figure even more," Domnarvet director Sten Forslund said. That would be most sensible from the standpoint of business economics.

Borlange has paid a high price for the structural change in the commercial steel industry. Unemployment will soon skyrocket. For over 100 years young people have more or less always found work "down at the mill." Now the gates are closed, however.

During the past 5 years the heavy plate, medium section rolling mill, the blooming mill, four smelting works, two Kaldo furnaces, and the sinter plant were shut down. Last fall the last smelting works was closed.

A mill with no smelting works is like a body with no heart, the people in the village said when the smelting works, the scintillating center of the mill, was

put out. Suddenly there was no one asking for several hundred workers' unique skills that had been handed down from one generation of foundry workers to the next.

"Demand continued metal production: could be seen in meter-high red letters painted on the overpass near the northern gate as we rushed past in Sten Forslund's car. Forslund was previously head of ore metallurgy along with its smelting works. Now he is head of the entire plant.

The guards in the booth recognize him and wave as we pass through the remote-controlled gates. We continue quickly past buildings closed for vacation and drive toward the "new" Domnarvet.

Work is in full swing, however, at the wide strip mill. People in different colored overalls from different contracting companies are gathered around Stig Oskar Persson, project leader for expanding the wide strip mill. A thorough modernization is underway and the capacity will be almost doubled to 1.2 million tons per year.

The first thing we see is the large new transforming station with new driving motors that will provide twice as much power as before.

About half of the ten or so Italians who are occupied with Band 82 are in the furnace plant. They are experts involved in assembling the new reheating furnace. Here the steel ingots from smelting works in Lulea and Oxelosund, as well as from Domnarvet's own-scrap-based electric furnace works, are heated before it is time for the ingots to be rolled.

The new reheating furnace will have twice the capacity of the old furnace: 300 tons will be heated every hour. This energy guzzler, which is oil-fired, will have advanced equipment for energy recycling. The principle is that the air of combustion is heated by the exhaust gases.

When an ingot has passed through the furnace it proceeds to the universal mill where its thickness is reduced by rolling before it enters the wide strip mill's so-called finishing mill where its thickness is further reduced.

Before the sheet enters the finishing mill, however, it passes through a coil box, which is the great innovation in this production line. The purpose of the coil box is to eliminate the problem of trains that are too short. The distance between the wide strip mill's breakdown rollers and finishing rollers is only 50 meters and this prevents rolling of longer ingots.

With a coil box the distance is increased, almost doubled. This means that ingots almost twice as long can be rolled by rolling up the sheet between the breakdown rollers and the finishing rollers. "Coil" is the English word for to roll up.

"The results are higher productivity, energy conservation, and more even quality," Sten Forslund said.

Higher quality is achieved primarily because an even temperature can be maintained. The coil box was assembled outside the rolling mill and when the wide band mill was closed for vacation it was simply installed on the production line. In addition, a new shearing section was installed, also with the help of the Italians.

The entire wide strip mill, from the point where ingots are inserted into the furnace to the end where the rolled sheet is reeled into a roll, is provided with a computerized process control system. The process is followed by way of numerical values on TV screens in the control room.

The rolls of sheet metal are taken by fork lifts to the cold rolling mill, which is now located inside the enormous blue and white building which now houses Domnarvet. The mill will be completely finished early next year.

The new pickling section stands finished beside a large and desolate warehouse space where the rolls from the wide strip mill will be stored. Here the oxide coating is removed by a series of baths in hydrochloric acid and water.

This August the next stage in the modernization of the cold rolling mill should be complete. The rolling mill, which presently has four pairs of rollers, will add a fifth pair. In the four older pairs of rollers the two working rollers (which are closest to the sheet) are each supported by a supporting roll.

The problem with these rollers is that they do not make the sheet sufficiently even. The rolling pressure has been least in the middle, so that the working rollers have been thicker in the middle to make the sheet even. Nevertheless, the evenness has not been satisfactory.

An extremely thin and even sheet can be produced with the new fifth roller. Here the two working rollers are supported not by two but by four supporting rollers. Two of these supporting rollers possess lateral mobility and thus they can even out the rolling pressure over the entire sheet.

The capacity will increase to 700,000 tons per year. This is 3.5 times more than what the four old rollers produced.

The fifth roller is being installed with the help of half of the 20 West German experts now working at Domnarvet. The rest of the Germans are working with the 10 Japanese on the next major project at the cold rolling mill: the continuous annealing line.

Here the sheet is annealed, trim rolled, and cut into rolls. Previously this process took 10 days. With new Japanese technology, however, it will take only 10 minutes. The time savings occur because the process is uninterrupted. It is now possible to eliminate the storing and cooling of the sheets between the various processes. Previously the sheet was heated in large, so-called bell furnaces and then cooled for 3 days before the final trim rolling. After that one was forced to wait again before the sheet could be cut and finished.

A new process has also been included before annealing. It is an electrolytic cleaning that further increases the quality of the sheet. Domnarvet will be the first to use this process in Europe.

After the electrolytic cleaning the sheet passes through the annealing zone which is fired with LP-gas. Annealing makes the sheet soft and ductile. Before annealing the sheet can be stretched only by 2 percent before breaking, while after annealing

it can be stretched by 35 to 40 percent. After annealing the sheet is cooled rapidly in water after which it passes through a pickling bath which removes the oxides that were formed in the water bath. After that the sheet is heated again to further increase its strength.

After the drum roller, where the final rolling occurs, it is at last time to cut the sheet into rolls.

"The result is a very clean sheet with good pressing qualities," Sten Forslund said. "We can go from 0.60 to 0.35 mm thickness without losing strength in the sheet.

It is this aspect that will attract the interest of the automobile industry; a strong, lightweight sheet that is ductile and easy to paint. "Presently we deliver only 20,000 tons of thin sheet annually to the Swedish automobile industry, but we hope that this figure will increase many times over," Forslund continued. After all, 60 percent of the thin sheet is now imported.

The Band 82 project also includes expansion of the coating section, a modernization of the coating plant where the older of the two hot-dip galvanizing lines has been converted to a so-called aluzinc line. Here the sheet is coated with a surface layer of aluminum and zinc. This line began operation in June.

It is estimated that in January of next year the Band 82 project will be complete. At that time the final stage, the continuous annealing line, will be complete.

"At that time we will show what we can do," Sten Forslund said, opening the door to his Volvo. Volvo will be one of Domnarvets most important customers in the future.

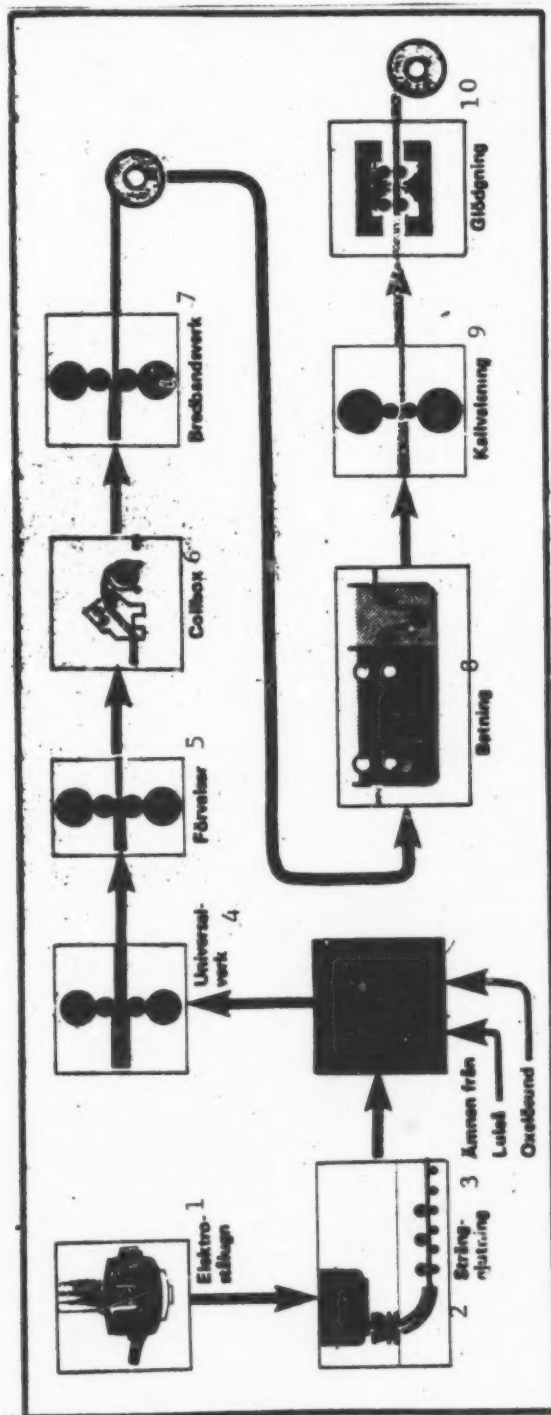
Path of steel in the new Domnarvet. From ingot to finished sheet.

Key to figure:

1. Electric furnace
2. Continuous casting
3. Ingots from Lulea Oxelosund
4. Universal mill
5. Breakdown roller
6. Coil box
7. Wide strip mill
8. Pickling
9. Cold rolling
10. Annealing

9336

CSO: 3102/409



SCIENCE POLICY

NATIONAL CONFERENCE ON RESEARCH, TECHNOLOGY LAUNCHED

Paris AFP SCIENCES in French 10 Sep 81 pp 1-5

[Excerpts] Paris--National conference on research and technology--Mr Jean Pierre Chevenement, minister of research, opened on the 8th of September the national conference on research and technology, " an initiative without precedent in the world," according to the minister.

This conference is to conclude with national science days, which will be observed from 13 to 16 January 1982 at the Palace of Congresses in Paris.

During these 4 intervening months, the 23-member national organization committee, chaired by Mr Francois Gros, director of the Pasteur Institute, will canvas the scientific community through research groups, learned societies, unions, businesses, etc, for their views on 6 major themes:

- 1) Scientific research and technology in relation to society: An important consideration will be the problem of the researcher's responsibility.
- 2) Research and technology: a choice and a strategy for the future.
- 3) The development of research and technology: a driving force for emerging from the crisis. It will involve focusing our thoughts, on the national as well as the international level, by examining the socio-economic impacts of scientific and technical progress, the problems of industrial research and the expansion of the public sector, research and technology in the Third World, etc.
- 4) Research and technology: men and organizations. This theme should encompass questions like the enhancement of the researcher's status and the vitalization of institutions, education for research and by research, employment in science, research in business, the transfer of knowledge, the stimuli and restraints to innovation, the regional dimension of research, etc.
- 5) Science and decisionmaking: beyond the scientific community, it seems absolutely necessary that laymen be able to articulate their views about the great problems arising out of scientific and technical progress; hence, the importance of disseminating scientific information and of public debates on the implications of science.

6) Implementing measures: the general idea of this last theme would be, somehow, to establish a great national goal in the context of a program law.

During the national days, preparatory acts will be presented to define "democratically" the broad features of the 4-year research orientation law to be voted on in the spring of 1982.

The industrial sector, which represents 58 percent of the research effort, will be associated with this undertaking. Public enterprise will take the lead because, according to the minister, "it's impossible to conceive of a policy of nationalization without national enterprises playing a predominant role." But the private sector is also included: plans call for fiscal incentives and funds resulting in the improvement of the technical centers, explained the minister.

The research effort to be accomplished is really very sizeable. In 4 years, the government wishes to increase research funds from 50 to 80 billion francs in order to reach, as has Japan or the FRG, 2.5 percent of the gross domestic product in 1985.

"We want this debate to be perfectly open," declared the minister, "particularly in order to counter the anti-science movement which has been showing signs of renewed vigor lately."

9816

CSO: 3102/433

SCIENCE POLICY

BRIEFS

SIX RESEARCH AREAS FOR STUDY--Paris--Study groups in six broad research areas--Six broad areas of French scientific research are going to be studied by six groups of prominent figures from the world of research and industry. An announcement on this subject was made in the August 9th Council of Ministers by Mr Jean-Pierre Chevenement, Minister of Research and Technology. These six areas are critical, according to the Minister, but they are not intended to detract from the other research sectors. They are biotechnology, the electronics industry, robotics and automation, research on employment and the improvement of working conditions, scientific and technical cooperation with developing countries, and new energy sources. The study groups created by the Minister of Research, in conjunction with other ministries, will mainly have to make an inventory of what exists in each area and propose a coherent policy for the coordination of teams and the training of people. These projects will be submitted to the Parliament at the time of the budget vote in the spring of 1982. Gradually the groups, which have no funds of their own, will be converted to national committees of an interministerial nature and, as of next January, will be able to participate in the national conference on research and technology. [Text] [Paris AFP SCIENCES in French 10 Sep 81 p 6] 9816

CSO: 3102/433

TRANSPORTATION

VFW STUDIES CAST-ALUMINUM ALLOYS FOR USE IN AIRCRAFT

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 8 Sep 81 p 5

[Text] Considerable cost savings and weight reduction can be achieved in the future with components of cast-aluminum alloys, not least of all because more individual parts can be manufactured from cast alloys than were previously considered possible. The Bremen aircraft construction firm VFW [Consolidated Aircraft Works] reached this conclusion on the basis of tests which have been running since 1978. In the company's view, however, a condition for the use of cast parts is that the metallurgical and design characteristics of the casting method are fully utilized. Analytical tests on components which were representative of individual subgroups had shown cost savings of 25 to 60 percent with simultaneous partial weight reduction.

It was necessary to establish the stress behavior of these compounds and compare it with riveted samples of forged-aluminum alloy to solve the problem of mechanically joining components of cast-aluminum alloys. The technical manufacturing tests were concluded with extremely good results and, in the view of VFW, confirm that the building-in of bonding elements (rivets) into cast-aluminum alloy components is possible in every case. As part of the test program, sample bars of the alloy A 357 are made from cast-aluminum sheets, joined with solid, blind and shoulder rivets and subsequently subjected to static and dynamic loads. Evaluation of the statistical tests showed that when solid rivets are used the stress behavior of the compound "cast-aluminum alloy A 357/bonding elements" is equal to forged alloy.

Comparative fatigue tests were conducted with various sample shapes, which were riveted with various types of bonding elements. Since the same tests were carried out at VFW on samples made of forged-aluminum alloys, it was possible to compare the two materials with regard to their fatigue-strength behavior. The result was: the fatigue behavior of the cast-aluminum alloy A 357 is not as good as with forged-aluminum alloys at higher loads. At lower load levels, according to VFW, the fatigue behavior of the riveted joint made from the cast-aluminum alloy was equal; at higher load reversals (longer loading) it was actually better than with forged-aluminum alloys.

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CSO: 3102/414

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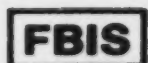
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West Europe Report

SCIENCE AND TECHNOLOGY

No. 79



FOREIGN BROADCAST INFORMATION SERVICE

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BIOTECHNOLOGY

BACTERIUM PRODUCES PROTEIN FROM METHANE

Duesseldorf VDI-NACHRICHTEN in German 7 Sep 81 p 7

[Text] Annually 50,000 to 100,000 tons of natural gas are still flared in the Persian Gulf alone. In the eyes of Dr. Monir Naguib that is an enormous waste of energy reserves. Instead of simply burning off the natural gas as a waste product of petroleum production, it could be used to produce protein. The basis for this is the capability of certain bacteria to convert the methane of natural gas into protein. Dr. Naguib and his colleagues at the Max Planck Institute of Limnology in Ploen have developed a process with which the protein known as single-cell protein (SCP) can be produced from natural gas in commercial quantities by bacteria.

Methane (CH_4) is the simplest hydrocarbon compound. It is the main constituent of natural gas, making up 80 to 90 percent by volume. In nature it results from fermentation processes, in ocean sediments for example. In their studies of ocean ecologies, the limnologists (inland water researchers) at Ploen have hit upon bacteria which feed on methane. They are thus called methanotrophic bacteria. They use the gas as energy and a source of carbon and build bacteria protein in the process. In this manner they influence not only the carbon and oxygen cycles in bodies of water but also represent a potential source of protein.

However, not all methanotrophic bacteria can be considered for the biotechnological production of protein from methane. Only those types are suitable which have specialized exclusively on methane and which cannot thrive on other carbon compounds such as carbohydrates. In addition they should have the greatest possible substrate conversion; that is, they should assimilate a large part of the methane carbon into their cells so protein production is correspondingly high. Naguib's studies have shown that several phyla, for instance phylum "M102," possess the required characteristics.

However, there were initial difficulties in attempting to develop an industrial biotechnology. The mass cultivation of methanotrophs required could not be induced; and the explosive nature of methane gas presented a technical risk. Dr. Naguib discovered the cause for the growth retardation: while growing, the bacteria excrete materials which strongly retards their further growth. He attached a dialysis system to the culture container which serves as an artificial kidney. Thus all retarding metabolic products can now be removed. This resulted in a 50-fold increase in production from 1 g to 50 g dry weight per liter of bacteria

culture. The second obstacle, the danger of explosion, can now be eliminated in modern bioreactors using a type of "air lift" which removes the flash mechanisms from the gas mixture.

The freeze-dried product is powdery and has no odor or taste. In dry form it contains 70 to 80 percent protein by weight. The quality of this bacteria protein is very high. It contains all of the health-essential amino acids. Thus the bacteria protein fulfills the requirements established by the World Food Organization FAO for biologically produced protein. That is, it may be used for food and feed.

Economically, the methane/SCP process would be especially advantageous if it were used locally where large quantities of natural gas are already being released.

9160

CSO: 3102/413

ELECTRONICS

ORGANIC LAYERS USED TO INSULATE SEMICONDUCTORS

Duesseldorf VDI NACHRICHTEN in German 7 Aug 81 p 4

[Text] Of course silicon is indispensable to semiconductor technology; however, there are areas of application in which it falls short. In the field of electronic sensors, in particular, other semiconductor materials have better properties; but applying an insulating coating to the surface of these crystals is a significant problem. Research has been underway for some time at the University of Durham in Great Britain on a coating process which employs the Langmuir basin. This work was reported at a recent meeting in Erlangen.

For a long time it has been known that many organic substances, primarily fatty acids and their salts, can float on pure water as a monomolecular film. This mechanism is operating when an oil spill spreads over the ocean's surface. The fatty acids were singled out for intensive study since their large molecules possess a hydrophylic and a hydrophobic end which cause the molecules to automatically orient themselves on the surface of the water.

If a semiconductor crystal is dipped into such a bath and pulled out, the film is lifted from the water and adheres to the surface of the crystal. By repeated dipping, additional layers can be added one at a time, provided that the surface tension of the film on the water can be held constant. With this Langmuir-basin method, a specified number of these monomolecular films can be transferred to a substrate. At the University of Durham, experiments are being conducted with various organic substances and various semiconductor crystals.

In the case of silicon the application of such insulating films is not necessary since the crystal surface automatically oxidizes to silicon dioxide. The insulating film required for the build-up of integrated circuits is thus inherently present. In the case of other semiconductor materials, such as indium phosphide, gallium arsenide, and cadmium telluride, such films do not develop automatically. Until now only a few laboratories have been successful in coating such semiconductors with insulating surfaces composed of inorganic substances.

In Durham the working group associated with Professor G. G. Roberts has been able to produce such clean boundary surfaces between a diacetylene-polymer film and an indium phosphide semiconductor that the material is suitable for the fabrication of field effect transistors. Equally satisfying results were achieved with 31 layers of a fatty acid salt on a crystal of cadmium telluride.

The effectivity of solar cells has been increased by up to 50 percent by applying 2 unimolecular films of C4-anthracene to a cadmium telluride semiconductor. Together the layers had a thickness of only 2.5mm. Intensive research is presently being conducted at Durham on the application of organic substances to cadmium-mercury telluride, the most important alloy for infrared detectors.

It appears that semiconductors coated with organic films are destined for use in areas other than just the field of radiation sensors (IR detectors and photovoltaic cells). Investigations at Durham showed that there were measurable changes in the spectrum of surface states of a semiconductor coated with a Langmuir film when it was placed in an atmosphere of ammonia, carbon monoxide or hydrogen. The electrical properties were altered by the chemical reaction between the film and the gas. Roberts concludes from this that future gas detectors can be produced with the Langmuir method.

The development of optical wave guides is a special target. The thickness and thus the refractive properties of the organic substances can be selected very accurately. Also, measurements have shown that low damping losses--down to 5 dB/cm--can be achieved in such films.

Organic materials as insulating films for semiconductors have not yet been applied on a technical scale mainly because much experimentation remains to be done on various organic substances whose electrical properties are not yet sufficiently known. Symposium attendees did not rule out the possibility that the Langmuir method can be developed into a commercial process, especially in view of the fact that the application of such surface films is simple and inexpensive.

9160

CSO: 3102/426

ELECTRONICS

NEW VAPOR-DEPOSITION DEVICE FOR SEMICONDUCTOR MANUFACTURE

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 7 Sep 81
p 7

[Article: "Improved Sputtering Method"]

[Text] Balzers AG, Balzers (Liechtenstein). In order to overcome the natural limits of vapor-deposition processes especially in the area of semi-conductor technology, Balzers AG, a subsidiary of the Swiss concern Oerlikon-Buehler, developed a new type of sputtering facility which they call the "Planar-Magnetron Thin-Film-Process System with Loading Lock." This system lends itself to the production of semiconductor components, opto-electronic components, hybrid circuits and chrome masks. It consists of a high-vacuum chamber with vaporization sources, a loading valve, loading chamber, pump system and control unit. By late fall 20 systems of this type will be in operation in Western Europe according to company information.

Up to five vaporizing sources can be attached to the high-vacuum chamber at the same time; these are also kept under vacuum. Several target combinations can be worked together with different processes; however, the up-time of the chamber is better for like targets. The capability to conduct residual-gas analysis (the substrates are already degased in the feed lock) ensures continuous monitoring of desired film properties such as hardness and resistance. According to the company, up to 60 100 mm-diameter substrates on a 600 mm-diameter substrate tray can be simultaneously coated in less than 30 minutes; however, the time depends on the particular batch process.

The pump system is equipped with a refrigerator-cryogenic pump. Pumping periods are short, amounting to about 8 minutes for a desired vacuum of 2×10^{-6} millibar. The total facility is computer controlled and equipped for single-button operation. The parameters are input via magnetic-tape cassettes. Control accuracy for current and power is closer than plus or minus 1 percent. The entire system is so designed that it can be installed and operated in a clean room with modification.

9160
CSO: 3102/413

ENERGY

ACTIVITIES OF UK IN FLUIDIZED-BED COMBUSTION RESEARCH

British Know-How Discussed

Graefelfing ENERGIE in German Jun 81 pp 223-225

[Text] The output range of the approximately 20 boilers, which are being operated in England as fluidized-bed-furnace experimental and demonstration system, extends from 0.35 to 30 Mw. This involves new units and remodeled units--in other words, there was hardly a boiler type which the English have not yet tried out. Licensees in the United States are selling fluidized-bed-furnace boilers like "hot-cakes" now. From the other side of the Channel, we are told "that there are no" problems with the furnace.

"You really ought not to be astonished over the fact that I do know something about fluidized-bed furnaces." This sentence may be typical English understatement because it comes from David Gray, the managing director of Coal Processing Consultants, Ltd., a joint enterprise involving the National Coal Board (NCB), Babcock International Ltd., and British Petroleum Company Ltd. (BP).

Gray was one of the conversation partners of the ENERGIE editors who took a closer look on the spot at the fluidized-bed-furnace know-how of the English. The other two were Bryan Beacham, manager of the BP Research Center, and Robert C. Payne, chief of the Combustion Division of the Coal Research Establishment in the NCB.

Although the English are in some areas further along in fluidized-bed furnaces than the boilermakers in the FRG, they are also having difficulties in making headway on the market. "Industry does not want any fluidized-bed furnaces and no coal; it only wants steam," says Gray whose consultants operate worldwide in the fluidized-bed furnace field.

The illustrations show how various enterprises are interconnected, under the direction of the NCB, to make common cause for fluidized-bed furnace operation. The benefits are supposed to go above all to coal with which the NCB wants to replace 50 million t of oil annually. Right now, about 1 million t of coal are annually being burned in England in fluidized-bed furnace systems. Just about 20 boilers (almost all test and demonstration plants) are working in the output range of 0.35-30 Mw; that includes all currently customary conventional boilers which were converted to fluidized-bed combustion.

Boilermakers and groups in the NCB cooperate closely and each of them benefits to some extent due to the exchange of information. BP with Bryan Beacham is above all interested in selling licenses. This came off quite successfully in the case of Jonston Boiler, in the United States, who have already sold 22 fluidized-bed furnace systems.

Gray's CPC has worked on 13 fluidized-bed furnace projects worldwide and is not tied to any English manufacturers. Feasibility studies in the sector of complete coal refining and fluidized-bed furnace engineering is the job of the 30 staff members who want to corner the market with small boilers.

Here is the No 1 fluidized-bed furnace problem for Gray: "There are no boiler engineers with experience in coal."

Whether it is the boiler or the pipes, there is no talk of difficulties with the fluidized-bed furnace as such; there are supposed to be tried and tested materials for heat exchangers and the combustion efficiency in all types tested is supposed to be more than 90 percent and with some skill that can go up to 98 percent.

Fully automatic operation, the charging and discharging of boilers--these are the things the engineers are concentrating on now. And that applies above all to small systems via which the road to big systems makes sense as Gray and Beacham agree.

If existing boilers are to be converted to fluidized-bed furnaces or if they are supposed to be replaced by them, then one must in the truest sense of the word cut one's coat according to the cloth: either according to the boiler height or according to the height of the room. Says Gray: "Height is a big problem and this is why we are experimenting in fluidized-bed combustion with all possible boiler types to gain experience.

Experience with desulfuration by the way can hardly be gathered in England--the law does not require it. Nevertheless Beacham and Payne maintain that there could not be any problems here. They probably know what they are talking about in the light of their license contacts with the United States.

There is much knowledge and experience coming from R. C. Payne's shop. The Coal Research Establishment in Cheltenham is a real treasure trove for people interested in fluidized-bed furnaces.

Starting with an output of 2 Mw, fluidized-bed furnace operation turns out to be worthwhile--Payne believes; work in the shops at the research center is oriented along these lines therefore. The emphasis here is on automatic charging and discharging of conventional small coal-fired boilers likewise.

The people in England are involved in detail work here. The conversation partners sound convincing when they maintain that there are no problems with boilers and their fluidized bed.

UK Enterprises Supplying Fluidized-Bed Furnace Systems

Babcock Contractors Limited, 165 Great Dover Street, London SE1 4YB.

Babcock Power Limited, Shell Boiler Division, 65 Livery Street, Birmingham, West Midlands B3 1HA.

Danks of Netherton Limited, 257 Halesowen Road, Netherton, Dudley, West Midlands, DY2 9PG.

Deborah Fluidised Combustion Limited, 6 Davy Drive, North West Industrial Estate, Peterlee, Co. Durham.

Energy Equipment Company Limited, Energy House, Hockliffe Street, Leighton Buzzard, Bedfordshire, LU7 8HE.

Forster Wheeler, Power Products Limited, PO Box 160

Great London House, Hampstead Road, London NW1 7)N

Gibson Wells Limited, 2 Town Gate, Calverley, Leeds, West Yorkshire LS28 5NF.

E Green and Son Limited, Calder Vale Road, Wakefield, West Yorkshire, WF1 5PF.

M E Boilers Limited, M E House, Fengate, Peterborough, Cambridgeshire, PE1 5BQ.

NEI (Northern Engineering Industries Limited), St. James Road, Gateshead, Tyne and Wear NE8 3HS.

NEI Thompson Cochran Limited, Carntyne Works, 300 Myreside Street, Glasgow G32 6BS.

Parkinson Cowan GWB Limited, PO Box 4, Burton Works, Dudley, West Midlands DY3 2AD.

Stone-Platt Fluidfire Limited, Unit 11, Washington Street, Netherton, Dudley, West Midlands, DY2 9RE.

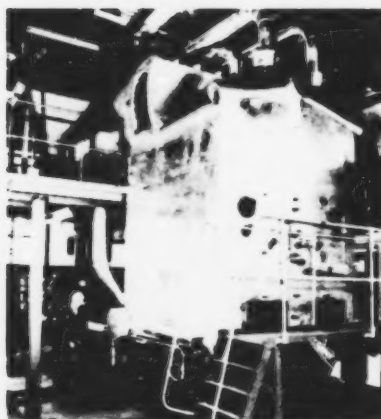
Vosper Thornycroft (UK) Limited, Northarbour Road, Cosham, Portsmouth, Hampshire, PO6 3TR

Furnaces

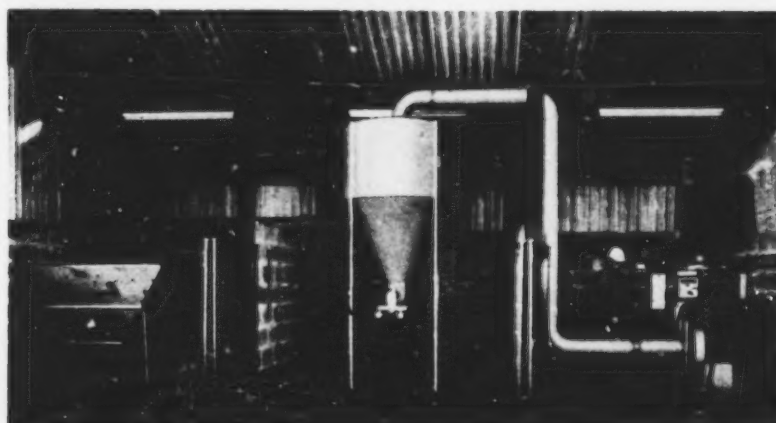
Energy Equipment Company Limited, Energy House, Hockliffe Street, Leighton Buzzard, Bedfordshire LU7 8HE.

G P Worsley & Company Limited, Haydock Lane Works, Haydock, St. Helens, Merseyside WA11 0UU.

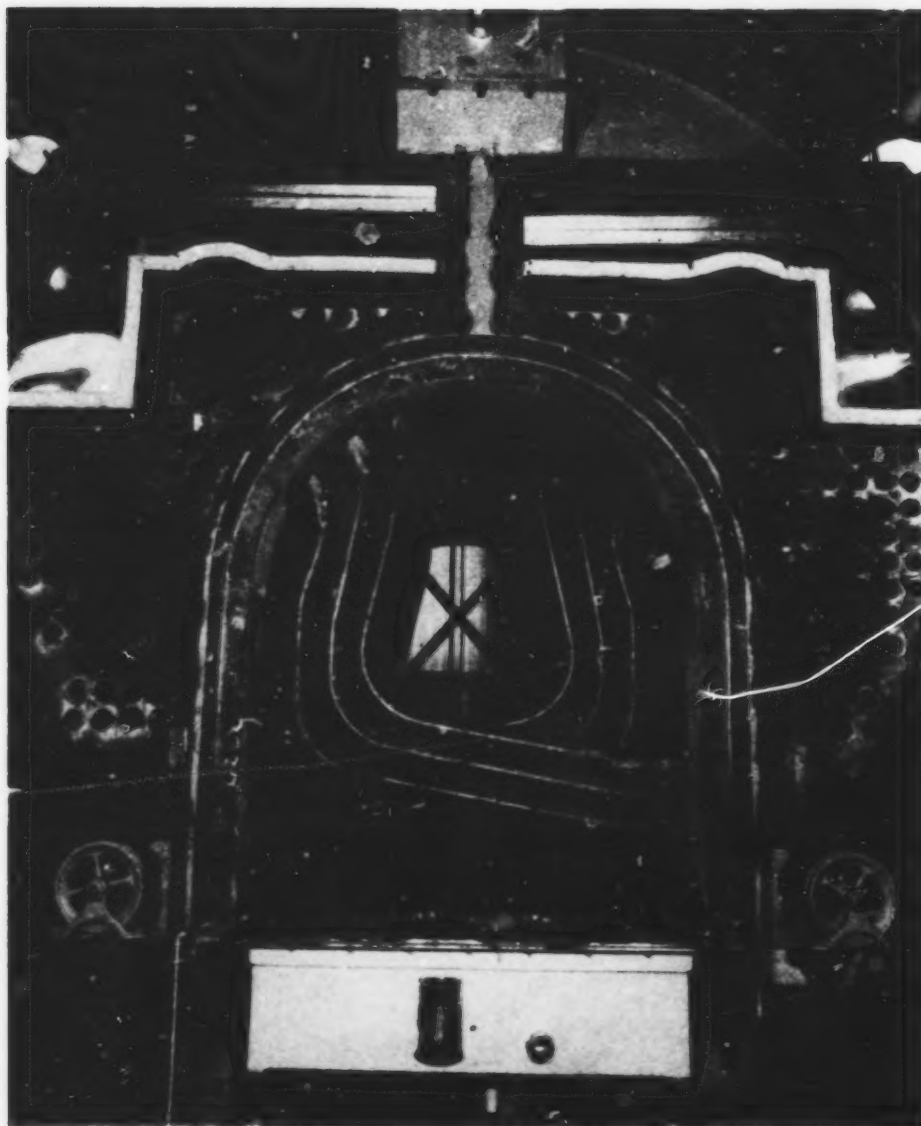
FIGURE CAPTIONS



This water-wall-pipe shell boiler was built by Babcock International Ltd. Some wall pipes run through the fluidized bed and work like thermosiphons. The water flows in a natural cycle. At an output of 4.3 Mw, the combustion chamber is 2.7 m high, 1.98 m long, and 1.7 m wide. The prototype is being tested in the Coal Research Establishment.



The National Coal Board developed a pneumatic coal conveyor system based on the suction-nozzle principle. The system comprises a special nozzle unit, corresponding pipes, a cyclone funnel and a suction fan. Via the suction nozzles there is generated the air flow with which the coal is moved to the cyclone funnel where the coal is separated from the air. A corresponding valve at the bottom of the funnel is used for control. The conveyor rates depend on the fan size, on the conveyed air speed, on the system length, and the pipe diameter. A typical short system is 10 m long, has a pipe diameter of 125 mm, and can move 16 t/hr. For classified coal with a magnitude of 12-25 mm, the system is now commercially available; for coal with a size of 0-12 mm, it is now being developed. The test plant is at the Coal Research Establishment in Cheltenham.



4



In this design by Wallsend Slipway Co. Ltd. (subsidiary of Vosper Thornycroft Ltd.) the point at issue was to increase the capacity of a horizontal-shell boiler. The boiler operates with a low furnace-air surplus; the increased vertical headroom reduces the material carryover from the fluidized bed.

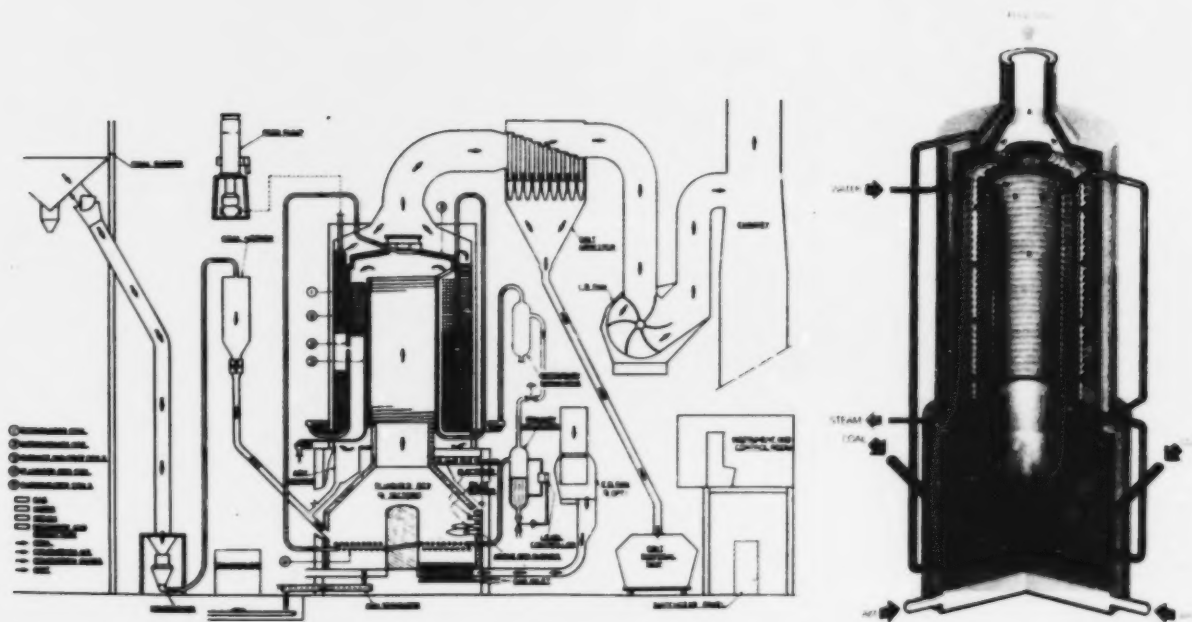
The boiler capacity is 5 MW; the dimensions of the boiler are 4 m high, 3 m in diameter and 3 m long, with a fluidized-bed combustion area of 1.5 m by 2.5 m. In the combustion chamber are 36 "thermosyphon" pipes in which the water circulates in a natural cycle.

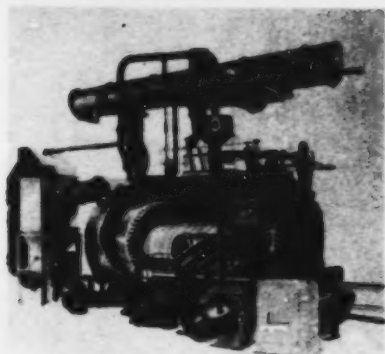
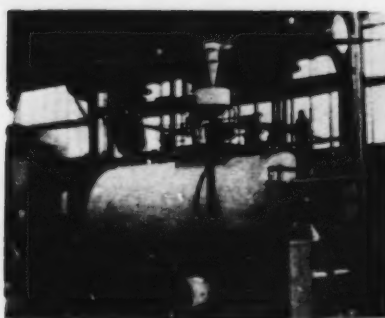
At present, the boiler is being tested at the Coal Research Establishment, Cheltenham.

Examples of Combustion Systems

Graefelfing ENERGIE in German Jun 81 pp 225-226

[Text] A 30-Mw fluidized-bed furnace boiler with water pipe coils has now been placed in operation by the British Steel Corporation, Riverdon Works in Sheffield. The plant comes from M. E. Boilers in cooperation with the National Coal Board. The special feature of this plant consists of six separate furnace elements and this is paralleled by the possibility of adjusting the boiler output. In the standard case, two of the segments are always working while the others are in the standby position. If the temperature drops below 650° C during the "break," then the other segments are turned off and the "cooled-off" segments go back into operation. The boiler is about 12 m high and has a bed diameter of 5.3 m. One can use coal with a size of 0-18 mm. The boiler works at 45 bar and 440°C with an output of 36,000 kg/hr.

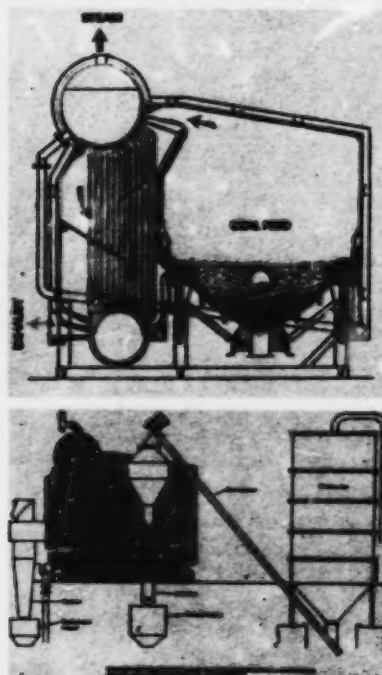




For steam output figures of about 5,000-12,000 kg/hr, Danks of Netherton Ltd. developed fluidized-bed boilers (horizontal shell boilers) which, according to the manufacturer, work at an efficiency of 80 percent. The company offers fluidized-bed-furnace water pipe boilers in the performance range of up to 45,000 kg/hr. The photo shows a horizontal shell boiler for about 8,000 kg/hr of steam.

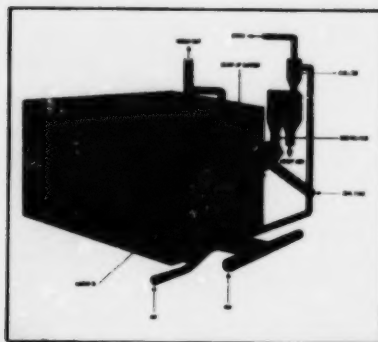
Compact Boilers

Stone-Platt-Fluidfire Limited believes that it has built and has on order the largest number of fluidized-bed furnace boilers. In point of fact, the enterprise is building or operating 23 commercial installations in the UK and the United States. The output figures are between 1,200 kg/hr and 25,000 kg/hr of steam. The photos show the compact water pipe boiler which is typical of the enterprise and which can be delivered for an output of 1, 3, 5, 7.5, and 10 Mw. Here are the price guidelines: 674,500 Pounds Sterling for 1-Mw boiler, 1,310,000 Pounds Sterling for the 3-Mw unit, 1,615,000 Pounds Sterling for the 5-Mw boiler, and 3,068,000 Pounds Sterling for the 10-Mw unit. The boilers can be equipped for desulfuration. The boiler shown in the photo is 4.25 m wide, 4.25 m high, and 11.5 m long.



Multifuel

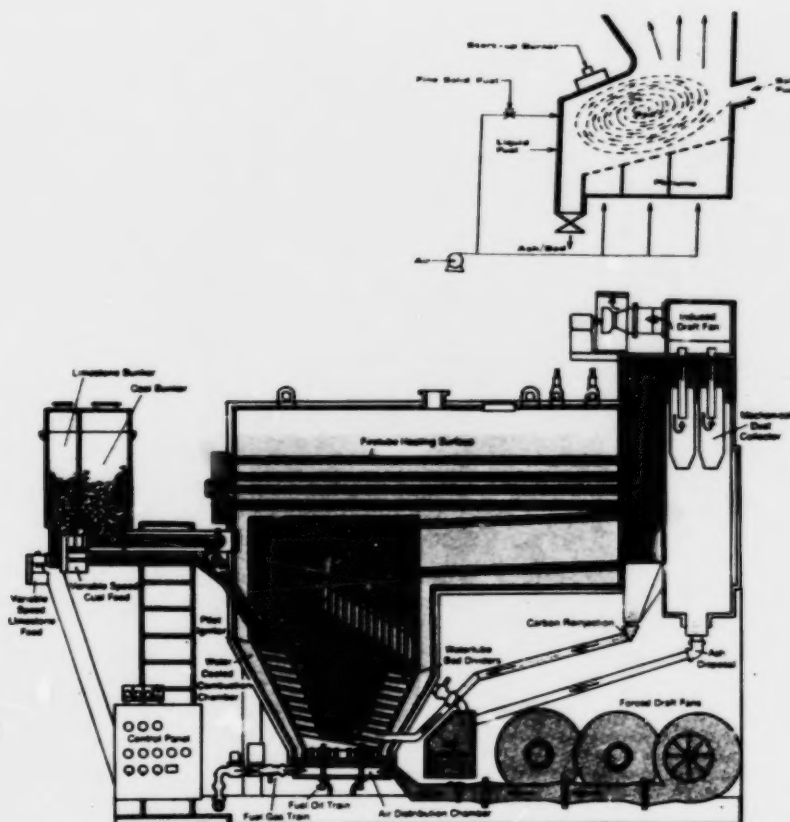
Deborah Fluidised Combustion (DSL) believes that it can convert just about all boilers to fluidized-bed furnace operation--of course they also love to sell new ones. The company has specialized above all in burning the most varied solid-gas and liquid substances and mixtures thereof. For solid fuels, DSL offers fluidized-bed furnace water pipe boilers in the range of 3-15 Mw and with superheated steam the company maintains that pressures of up to 64 bar are possible. An experimental boiler reportedly yielded a combustion efficiency of up to 1.44 Mw/m^3 , whereby the boiler efficiency was 80-82 percent.



DSL fluidized-bed furnaces are to replace underfeed furnace operation.

Desulfuration

Locomotive boilers by Johnston Boiler Company, United States (license from Combustion System Limited). The boiler links a vertical combustion chamber with horizontal flue-gas pipes. The water is heated partly by the pipes which are dipped into the fluidized bed and partly in pipes which run laterally thereto over the fluidized bed and also by the flue-gas pipes which lie in the water. The fluidized bed, consisting of limestone, sand, and ash, can be taken out of the boiler entirely for maintenance purposes. The boiler is available for commercial employment in sizes of 1-15 Mw output and pressures of up to 20 bar.



5058
CSO:3102/402

ENERGY

REPORT ON NATIONAL WIND-ENERGY RESEARCH PROGRAM

History, Present Status

Amstelveen ENERGIESPECTRUM in Dutch Jul-Aug 81 pp 172-177

[Article by P.F. Sens]

[Text] The "Wind Energy in the Netherlands" conference is the first to be devoted to a national research program. For that reason it seems desirable to analyze what a national research program consists of and wherein it differs from other programs. The national character of these programs, of which wind is not the only one, expresses itself in the cooperative association between institutions of higher education (universities and university-level institutes), research institutions (such as the National Air and Space Travel Laboratory, TNO [Netherlands Central Organization for Applied Natural Scientific Research], and ECN [Energy Research Center of the Netherlands]), industry, national institutes such as the KNMI [Royal Dutch Meteorological Institute], and consulting and engineering offices. The carrying out of national programs is thus not assigned to one specific institution, but to a number of parties that are asked to come and sit at the table of the program and contribute their own specific expertise. It is the intention to engage these specific expertises in the program, but not to concentrate them at one place. The desire sometimes expressed to establish a specific institute for wind energy must also be considered in this light. Sweeping these parts of the research together in one place would take them away from the soil in which they are now thriving.

The multidisciplinary character of the program, to which many parties make a contribution, does, of course, call for a definite administrative organization and a central point where the achievements of the program and the results can be worked up and evaluated.

In 1976 the authorities asked ECN whether ECN could in this sense take on the program direction and the program management of national research programs and what organizational measures ECN could take for that purpose. ECN gave a positive response and in 1976 established the Bureau of Energy Research Projects,

which is organizationally under the ECN, but works directly under the government and reports to the government. With regard to their content the research programs coordinated by the Bureau of Energy Research Projects do not come within the ECN's field of responsibility, and there is no question of ECN management except for the part played by the ECN in carrying out a program. It is perhaps well to point out emphatically here that the national research programs are neither a program of the Bureau of Energy Research Projects nor a program of the ECN, but a government program. In the case of wind energy the funds are made available by the Ministry of Economic Affairs; the coordination and the management are assigned to the BEOP [Bureau of Energy Research Projects]. The carrying out of a program is monitored by a monitoring commission appointed by the minister, which reports regularly on the progress of the work. As coordinator and manager, BEOP often organizes the creation of program proposals or of proposals for follow-up programs, but these must be accepted by the government and incorporated into the government's energy program in order to be carried out. The BEOP's task in the national programs is independent of whether the ECN is or is not involved in the carrying out of the program. The two functions, management and participation in the execution, are strictly separated.

The fact that BEOP "resides" at ECN has a number of practical advantages with respect to its being able to make use of the infrastructure present at ECN, especially in the field of administration, juridical, and technical assistance in management tasks, and, for example, in organizing a big conference. BEOP cannot undertake all this alone, with a total complement of 10 persons for, at the moment, 5 programs to be managed.

In the course of the conference a number of parts of the National Wind Energy Research Program will be discussed in the various lectures. For that reason, in this bird's-eye view the emphasis will be laid on the subjects that are not a part of any of the later lectures. In addition it should be pointed out that one lecture, Mr Smulders's, is devoted to the other wind energy research program, for the benefit of the developing countries. That program is financed by the Ministry of Foreign Affairs within the framework of technical assistance to countries of the Third World. A good cooperation is maintained with the program and there is a regular exchange of information.

The aim of the National Wind Energy Research Program is to answer the question whether wind energy in the Netherlands can make a significant contribution to the energy supply. This program was formulated in 1975 by a study group from the National Steering Committee on Energy Research. The proposed program was to run for 5 years and began on 1 March 1976. We are thus now at the end of the program. On behalf of the Bureau of Energy Research Projects the present status has been evaluated and set down in a report. This report is the subject of Mr Pelser's lecture.

The evaluation sets forth what has been achieved and where there are still gaps. On the basis of this a follow-up program under the direction of the BEOP has been formulated that is explained in Mr Piepers's lecture.

With respect to the decentralized use of wind energy this follow-up program has been accepted in principle by the minister of economic affairs. Mr Beurskens's lecture is devoted to this subject. The budget available for the program looks as follows:

At the beginning, on the basis of the original proposal, the minister of economic affairs promised a sum of 15 million guilders for a 5-year program. In the fall of 1978 an inflation correction of 3.5 million guilders was added. In the course of the program it was considered desirable to fit out the 25 meter horizontal-axis turbine that was to be built as a measuring installation rather than a prototype operating machine. Chiefly to meet the extra costs for measuring instruments involved in this, a supplementary budget of 700,000 guilders was granted. In addition, a sum of 900,000 guilders was voted by the Ministry of Science Policy for a number of specific projects in the field of decentralized use and the development of tipvanes during the years 1979 and 1980. The total amount thus comes to 20.1 million guilders, not including the ECN's own costs both with respect to participation in the carrying out of the program and with respect to performance of the management tasks. This participation of ECN not appearing in the budget has gradually increased and now amounts to a financial value of about 2.5 million guilders a year. If we had to divide the program of the past 5 years into 3 main subjects, they would be:

- Central application of wind energy,
- Decentralized application of wind energy, and
- Basic research.

In rough outline the distribution of the budget over these three main subjects is:

- Central application: 9.5 million guilders,
- Decentralized applications: 3.7 million guilders, and
- Basic research: 6.9 million guilders.

Table 1. Financial Means of NOW [National Wind Energy Research Program]

Ministry of Economic Affairs	Guilders
5-year Budget for 1976-1981 (1975 level)	15.0×10^6
Correction for inflation in the fall of 1978	3.5×10^6
Supplementary grant for 25-meter horizontal-axis turbine	0.7×10^6
Ministry of Scientific Policy	
Supplementary grant for tipvane project and decentralized applications	0.9×10^6
Total*	20.1×10^6

*Exclusive of the ECN contribution in manpower, now ca. 2.8×10^6 a year.

Allegations that in the National Wind Energy Research Program only 3 percent of the budget is devoted to small-scale applications must thus be blamed on incomplete information. The basic research is for the benefit of both the central and the decentralized part of the program.

The program has gone through the following phases in time:

Phase 1 from March 1976 to June 1977. In this phase the first studies were started up and an inventory was taken of the available knowledge in the Netherlands and abroad. At the same time the 5-meter vertical-axis turbine was built and set up at the Fokker plant at Schiphol-Oost.

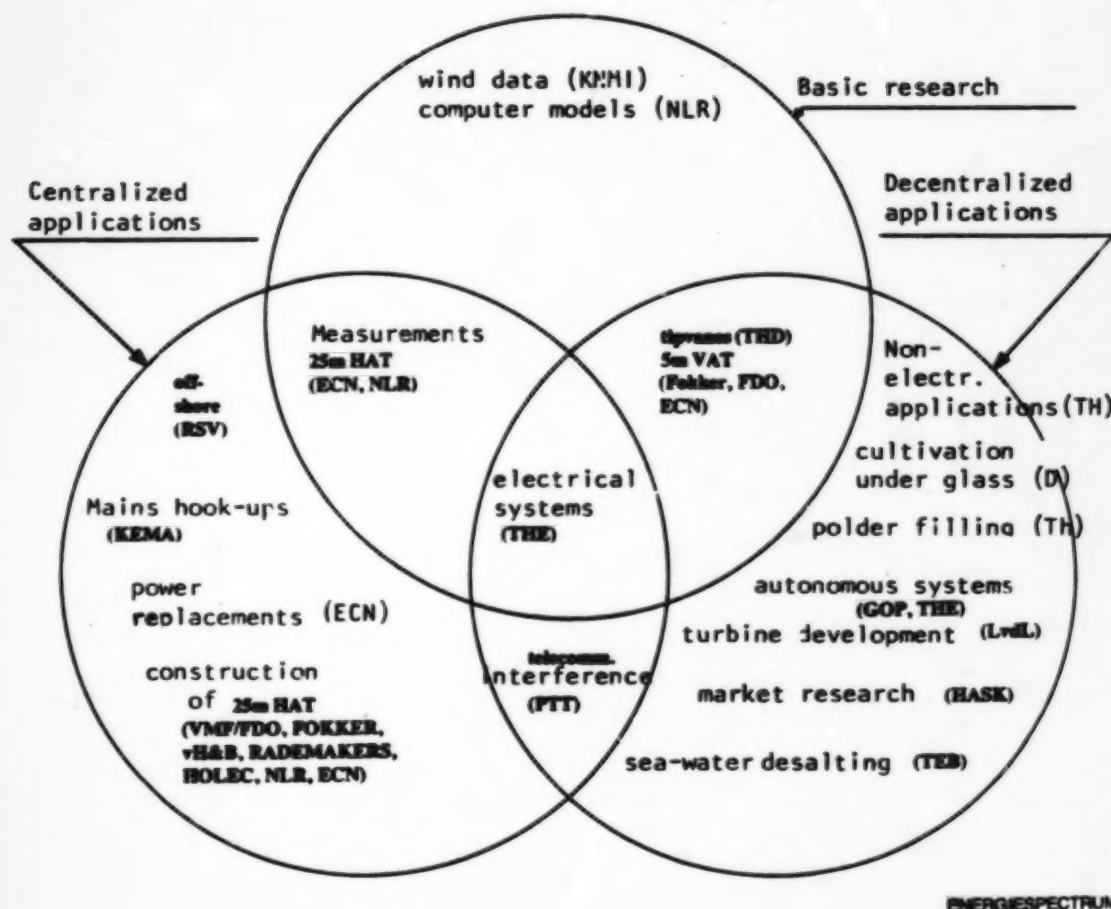


Figure 1. Principal Subjects of the National Wind Energy Research Program.

Abbreviations:

D Drayer
 ECN Energy Research Center of the Netherlands
 FDO Physics-Dynamics Research Laboratory
 GOP Goppel Engineering
 HASK Haskoning
 HAT horizontal-axis turbine(s)
 KEMA Office for the Inspection of Electrotechnical Material
 KNMI Royal Dutch Meteorological Institute
 LvdL Lagerwey v. d. Loenhorst

NLR National Aeronautical and Astronautical Research Institute
 PTT Post, Telephone, & Telegraph
 TEB Tebodin
 TH Technical University
 THD Technical University of Delft
 THE Technical University of Eindhoven
 VAT vertical-axis turbine(s)
 vH&B Van Hattum and Blankevoort
 VMF [expansion unknown]
 VMP United Machine Works

Phase 2, from June 1977 to the end of 1978, was chiefly taken up with measurements with the 5-meter vertical-axis turbine and the design of the 25-meter horizontal-axis turbine.

Phase 3, the last 2 years, has seen the construction of the 25-meter horizontal-axis turbine and the starting up of a number of activities concerned with decentralized use of wind energy.

This rough outline does not do justice to the numerous studies and developments in the program, only a part of which, as remarked earlier, will be up for discussion during the conference. For that reason a complete picture of the parties involved in the program is given in Table II, with an indication of the activities carried out by those parties.

The Royal Dutch Meteorological Institute has taken care of making wind data available. This subject will be discussed by Mr Builtjes, whose lecture will also deal with the research done at TNO on suction effects in wind turbine complexes.

The air and space travel department of the Technical University of Delft has been engaged in developments of the tipvane concept. These are small transverse wings set at the end of the rotor blades which have the effect of increasing the mass flow over the rotor surface. Theoretical and experimental findings show that a drastic increase in yield can be attained in this way. At the moment there is a test installation at the Stichting Energie Anders [Alternate Energy Foundation] in Hoek van Holland where the concept will be tested out under real conditions. Thus far measurements have been done chiefly in a wind tunnel.

Rijn-Schelde-Verolme, with Hydronamic as a subcontractor, has been engaged to do a study of possible sites for wind turbines at sea and the costs connected therewith. It appears that three areas in the North Sea may be considered for the purpose, but the most northerly area is so remote that it will certainly not be the first choice. It must be taken into account that energy supplied in this way will certainly be twice as costly as that from wind turbines on land.

The KEMA at Arnhem has been engaged in studies concerning fitting wind energy into the electrical network and the fuel to be saved in that way. This will be discussed in greater detail in Mr Van Nielsen's lecture. FDO-Technical Advisers, a VMF working group, has been engaged in an early stage of the program in the instrumentation of the 5-meter vertical-axis turbine, built by Fokker, and in a later phase with the design and consultation concerning the construction of the 25-meter horizontal-axis turbine. This is sure to be discussed in Mr Reijnders's lecture.

This 25-meter installation includes a number of components that are the result of research and development work entrusted to various concerns in the early stage of our program. This is especially true of Fokker, which after construction of the 5-meter vertical-axis turbine began research on production methods for manufacture of the rotor blades of the 25-meter HAT. The final result of this was that the rotor blades were indeed manufactured by Fokker.

The National Aeronautical and Astronautical Laboratory [NLR] made a contribution to the development of computer models for rotor systems; the NLR has also been closely connected with the setting up of measurement programs and the selection of measuring apparatus for both the 5-meter vertical-axis turbine and the 25-meter HAT.

The conversion of mechanical energy into electrical energy in a usable form has been the subject of research and development both at the Technical University of

Eindhoven and at HOLEC [electrical equipment firm⁷]. The electric apparatus in the 25-meter HAT was determined upon in repeated consultations between these two parties and the ECN, and was ultimately manufactured and supplied by HOLEC. The gearbox of the wind turbine is the result of research and development work at Rademakers Aandrijvingen [Rademaker's Drive Systems] in Rotterdam.

Table II. Participants in NOW [National Wind Energy Research Program] *

KNMI	- wind data over land and sea - vertical velocity profiles - turbulence - predictability
TNO	- suction effects in turbine installations
TH Delft	- "tipvane" development
RSV [Rijn-Schelde-Verolme]	- installation of wind turbines at sea
KEMA	- integration of wind turbines into the electrical net
FDO	- instrumentation of the 5-meter HAT - design and construction consultation on the 25-m HAT
Fokker	- design, construction, and operation of the 5-m VAT - development and manufacture of rotor blades for the 25-meter HAT
NLR	- computer models for rotor systems - measurements at trial installations - instrumentation and measurement program for the 25-m HAT
TH Eindhoven	- electrical systems for converting mechanical energy into electrical energy
HOLEC	- evaluation of electrical systems - construction of the electrical system of the 25-m HAT
Rademakers	- regulable planetary gear transmissions - development and manufacture of the planetary gearbox for the 25-meter HAT
Van Hattum & Blankevoort	- design and construction of the foot of the tower of the 25-meter HAT
ECN	- working up the measurement data from the 5-m VAT - operation and measurement program of the 25-m HAT - potential and costs of wind energy - power replacements - evaluation

*Other abbreviations are explained as far as possible on first occurrence; see especially the expansions below Figure 1.--Translator

As the last party that has been involved in the construction of the 25-meter HAT we may mention Van Hattum and Blankevoort, who undertook the civil engineering work.

Table III. Participants in the Work on Decentralized Applications

Drayer	- use in cultivation under glass
Theyse	- non-electrical applications
	- polder draining
Haskoning	- initial exploration of export possibilities
Tebodin	- use in desalting sea water
Dynaf	- agricultural use (cold storage)
Lagerwey v.d. Loenhorst	- turbines for decentralized applications
Goppel Engineering	- wind turbine-diesel motor combination
PTT	- interference in telecommunications

ECN's involvement has increased gradually in the course of the program. At the beginning ECN was not involved in the execution at all. When a measurement program was carried out in connection with the 5-meter vertical-axis turbine, it was found that ECN had the apparatus and the techniques "in house" for processing great quantities of measurement results. The statistical techniques had been developed within the framework of measurements of neutron noise in nuclear reactors. ECN thereupon became a partner in the program surrounding the 5-meter HAT. Later ECN's involvement has steadily expanded, especially as Petten was chosen as the site of the 25-meter HAT.

The situation now is that ECN will take care of managing the operation of the 25-meter HAT and also carry out the measurement program and analyze the measurement results. In addition, a definite project group is being formed at ECN which BEOP can call in in connection with appraisal of the numerous questions that arise in the field of wind energy.

In the field of decentralized application of wind energy a number of activities have been started up, which are shown in Table III. The Drijer* Engineering Office has made a study of the possibilities of application of wind energy in cultivation under glass, the idea being direct excitation of heat. A trial project in this field is in an advanced stage of preparation.

Theijse* Engineering Office made a study of the application of wind turbines for polder draining. A detailed plan is now completed and we hope to begin soon with a first trial windmill.

A first start toward study of export possibilities for our industry in the field of wind turbines has been made by the engineering office of Haskoning at Nijmegen. On behalf of BEOP, Tebodin has done a comparative study of the possibilities of using wind (and also solar energy in this case) in the various water desalting processes.

Dynaf, at Alkmaar, has done a system study and made a sketch for a combination of a wind turbine and a heat pump to generate electricity for a dwelling house and a cold-storage house for agricultural products. The wind turbine necessary for this was established not long ago in the testing field at ECN and will be tested, measured, and appraised for safety there. Goppel Engineering in Rijnsberg, under

*Spelled Drayer and Theyse respectively on Table III.--Translator

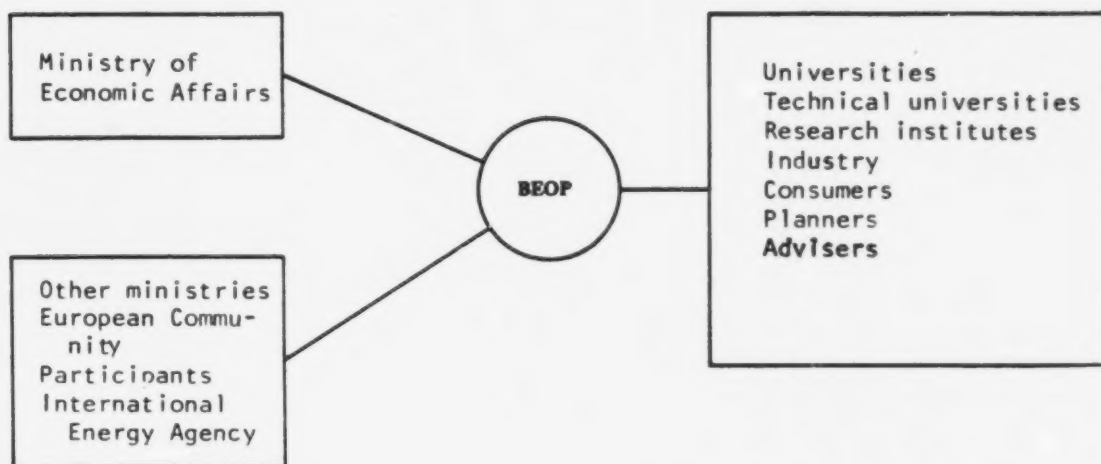


Figure 2. Organization of Wind Energy Research.

contract with the National Research Program, is studying an autonomous system consisting of a combination of a diesel motor and a wind turbine.

The research done by the PTT [Post, Telegraph, and Telephone] on possible interference with telecommunications by wind turbines may be regarded as a common part of the programs.

It should also be mentioned that through the cooperation of the National Planning Service, KEMA, and the Ministry of Economic Affairs, a first study has been done of the planning aspects of the use of wind energy. Mr Van Essen's lecture deals with this. In Figure 2 an attempt is made to group the subjects that have just been run through in such a way that their involvement in the search for central and decentralized applications and in basic research is made clear. A large number of subjects are of significance to one of these categories as well as another. In his lecture Mr Pelser goes into the results attained for a number of matters; we are contenting ourselves here with this factual summing up of the activities.

In conclusion, something about the international cooperation in the field of wind energy. The Netherlands is a participant in the wind energy program of the International Energy Agency in Paris and has in fact played an important initiating part there. In particular, research on the suction effects and on the interference with telecommunications constitute a part of the international cooperation.

In the European Community's program only a very small part of the budget is devoted to wind energy as a part of the solar energy program, but there is a good chance that there will be a change here in the coming years. The Netherlands is actively involved in the discussion of this matter within the EC.

In addition, a bilateral cooperation has recently been established with Indonesia, and recently two Indonesian engineers worked for 5 months in Petten on the 5-meter Darrieus turbine program. This turbine, which has already played out its part in our own program, was moved 6 months ago from Schiphol to Petten, where it was rebuilt and reinstalled. Within the framework of the cooperation with Indonesia,

the machine will be turned over to the Indonesian institute for aeronautics and astronautics.

Lastly, two final observations. It can be stated that the scope of the wind energy program has increased over the past 5 years. The program has grown and will continue to grow in the future. The follow-up program that is being formulated by BEOP is of greater scope than the program carried out hitherto. In that connection BEOP's management functions are also expanding, and it is absolutely necessary for the staffing to be adapted to this growing situation.

A second observation has to do with the rôle of Netherlands industry in the wind energy program. Thus far the industrial part has been nearly 100 percent paid for out of the program, but the time seems to have come when Netherlands industry must participate in and contribute to these developments partly on its own, if it does not want to lag behind foreign industry. It must be conceded that foreign industrial concerns are going to play a more and more active part in the field of wind energy in the Netherlands. This applies both to centralized and more particularly to decentralized applications.

A certain reserve on the part of Netherlands industry is to be explained, of course, by the fact that there is as yet no concrete prospect of a Netherlands market. For that reason it would be greeted with applause if a clearer picture could be obtained of public policy with regard to the use of wind energy in this country. Can we really interpret the 2,000 MW from wind energy mentioned in the government's energy paper for the year 2000 as a concrete market figure, and if so, by what means does the government intend to achieve or even encourage that? It would mean that between now and the year 2000 two wind turbines of about 50 meters in diameter, twice the dimensions of the Petten windmill, would have to be put into service every week. What figures can we assume with regard to the decentralized applications of wind energy? Clarity in this could be an important stimulant to getting industrial activity started in the field of wind energy.

The answer to the question whether wind energy can play a significant part in the Netherlands energy economy is that there are enough positive prospects in sight to encourage the application strongly and to continue the research directed to that end.

Continued Studies Planned

Amstelveen ENERGIESPECTRUM in Dutch Jul-Aug 1981 pp 201-204

[Article by G.G. Piepers]

[Text] The National Wind Energy Research Program (NOW) formally ended on 1 March 1981. The aim of the program was not primarily to fill up our country with windmills, but to investigate how the wind as a source of energy could make a contribution to the energy supply, with the principal aim of saving fossile fuels.

The results of the 5-year research and development work are set forth in an evaluation report. The final report also includes conclusions and recommendations, the most important of which are:

- Wind energy offers sufficient prospects to provide a powerful stimulus to make use of it;
- Before its large-scale introduction can be justified, however, a large number of bottlenecks need to be eliminated;
- Elimination of the bottlenecks can be effected in part by carrying out a follow-up program.

The favorable prospects have to do both with centralized application--production of electricity by wind power plants--and with decentralized applications. In the latter case the consumer of energy has his own windmill.

Decentralized use can generally be realized in a shorter time than the construction of wind power plants, because:

- The technical problems involved in small to medium-sized windmills can be solved more readily;
- The amounts needed for financing are limited in scope;
- The interest on the part of potential consumers is great; and
- The use of wind power is already beginning to be economically attractive to certain categories of consumers.

The authorities can have a stimulating influence by:

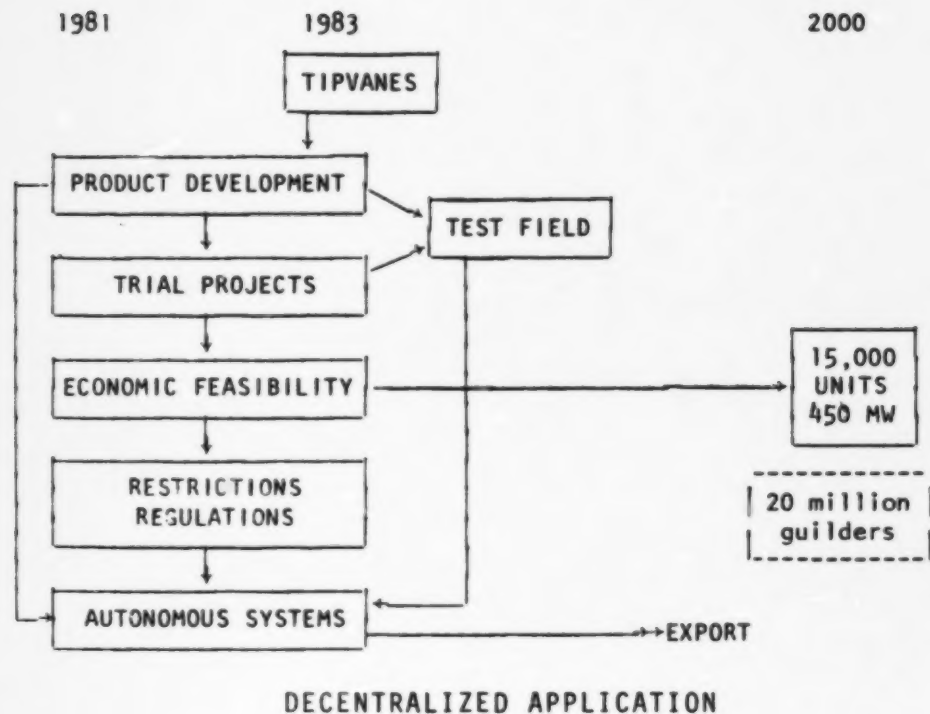
- Granting subsidies and development credits;
- Getting rid of all sorts of interfering restrictions; and
- Issuing unambiguous safety regulations.

The electric companies can make a contribution by allowing large-scale parallel operation with the public network and giving a reasonable compensation for the electricity supplied to the network.

The situation is much more complicated for centralized application. Because of the large investments necessary, the realization of wind power plants is possible only if a number of conditions are met:

1. The use of wind as a source of energy should be a part of an energy policy to be pursued by the public authorities. This implies taking such measures that the 2,000 to 3,000 large windmills in the year 2000 mentioned in the government's energy paper can be realized.
2. A positive attitude of the Cooperative Power Production Plants (SEP) with regard to the incorporation of wind-generated power into the electricity-producing facilities.
3. Willingness of Netherlands industry to set up a production line for the manufacture of large numbers of large windmills.

Now it is self-evident that in the last case the large investments involved are justified only if the government maps out a clear policy line with regard to the use of wind energy.



The "Wind Energy Systems Act" of 1980 in the United States can serve as a model for this. It establishes by law that in 1988 a wind power of at least 800 MW must be realized, 100 MW of it on a small-scale basis.

Without waiting for the official reactions of the authorities to the recommendations of the final report, the Bureau of Energy Research Projects (BEOP) of ECN [Energy Research Center of the Netherlands] has made a good start on the formulation of a follow-up program. The problem here, however, is that such a program should be attuned to the energy policy to be followed by the authorities. It must be a task-setting program, aimed at the introduction of a definite wind power within a specified period, as is the case, for example, with the American program.

The follow-up program to be presented is made up of three main parts:

- Decentralized application;
- Centralized application; and
- Basic research.

The follow-up program also contains sections dealing with international cooperation, with organization, and with financing.

Each main part embraces a number of related subprojects that have to do with specific aspects of the technical, economic, and planological problems. The aim of the program is set forth as follows:

- Doing research and development work;

- Giving support to firms;
- Advising government agencies, so that after a period of 3 to 5 years wind energy systems can be available with which wind power can be justifiably incorporated into the national energy supply on a large scale, so that in the year 2000 at least 15,000 small windmills (total power 450 MW) and 1,000 large units in wind power plants (total power 2,000 MW) have been installed.

Decentralized Application

Decentralized application embraces the following component projects:

1. Product development; i.e., design and construction of cheap and reliable windmills with capacities of 10 to 100 kW.
2. Feasibility studies; i.e., finding out for what categories of consumers application is attractive or is becoming so.
3. Finding out how obstacles can be eliminated; setting up regulations concerning safety and prevention.
4. Carrying out a number of test projects for specific applications.
5. One important component project is development of autonomous systems; i.e., the windmill-diesel generator combination. The potential applications are enormous; there are good export possibilities here for Netherlands industry.

In connection with the continuity of the activities of the various participating institutes and firms involved in the NOW and the very great interest of potential consumers, as early as November 1980 BEOP presented proposals for a 3-year small-scale program. Agencies have cooperated in the realization of the decentralized program that had already pleaded independently of the NOW for the carrying out of a small-scale wind energy program.

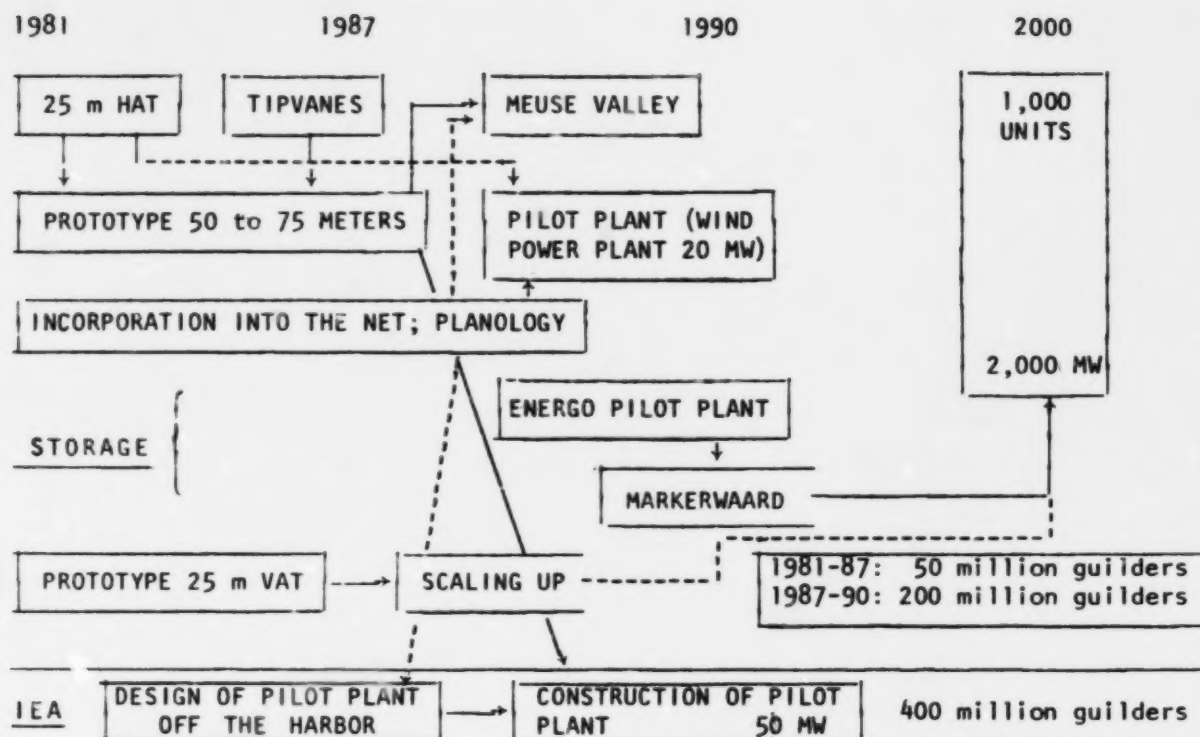
The minister of economic affairs has since approved the program in principle. But the carrying out of the program is subject to the condition that each component project requires separate approval of the minister. In practice this requirement has been found to have a rather restraining effect on BEOP's readiness for action.

Centralized Application

Centralized application involves the construction of wind power plants consisting of large numbers of large windmills. The three most important bottlenecks are:

1. Design and construction of cheap, reliable windmills at an economically justifiable price.
2. Incorporation of wind power plants into the system of conventional electricity-producing units so that a substantial saving in fossile fuels and in conventional capacity is achieved.
3. Making suitable locations available for the required numbers of windmills.

In the Netherlands we hope to master the technical problems by carrying out experiments with the windmills at Petten. The carrying out of a testing program is also



CENTRALIZED APPLICATION

the first component project in the centralized program. The next component project embraces design, construction, and testing of a prototype windmill with horizontal axis of optimal dimensions for use in wind power plants. Last are the findings with the windmill with vertical axis, since further study is necessary of whether this type is also to be considered for large-scale application.

For that reason the construction and testing of a vertical axis prototype with a diameter of 25 meters has been adopted as a component project. The design has already been completed. For both types it is necessary to find firms that are willing and able to set up a production line on the basis of their own design.

At one time there was an effort to get Netherlands industry involved as much as possible in the construction of the 25-meter HAT. It had only limited success. Furthermore, Fokker is not planning to manufacture rotor blades in the future.

In the program proposals the design, construction, and testing of a "pilot" wind power plant consisting of 10 to 20 units with a total rated capacity of 20 MG is included as a component project. A site somewhere in North Holland is under consideration, not too far from ECN at Petten. The Provincial Electric Plant of North Holland (PEN) has agreed in principle to cooperate.

The incorporation of wind power plants in Netherlands electricity production requires further study. This should not be based entirely on the structure planned by the KEMA [Office for the Inspection of Electrotechnical Material], according to which wind power is regarded as more or less an alien element. Study should

also be devoted to what a system of generating plants will look like if consideration is given to as great a wind-generated capacity as possible from the outset.

Although it is really a part of the decentralized application, because of its size a component project for use of wind energy for the benefit of an industrial concentration in the Meuse valley should be included. Ten large windmills or so, located together at a suitable spot in or near the Meuse valley, would supply electricity for a number of large industrial plants that use a great deal of energy. Connection with the electrical network would of course be necessary to take care of periods with little wind. Since the industries in question can absorb all of the energy supplied by the windmills, the quality of the current supplied need not meet the high requirements set by the network.

Within the framework of the National Wind Energy Research Program and also in cooperation with Great Britain, the United States, and Sweden and in relation to the IEA [International Energy Agency], the combination RSV [Rijn-Schelde-Verolme] and Hydronamic has done a study concerning the setting up of windmills at sea. It is the intention that the four countries will present a proposal to the IEA for working out a joint plan for an offshore installation of a specified size, to be situated at one or more locations previously agreed upon. In addition to production of electricity, the possibilities of hydrogen production are also being looked at in this connection.

An important disadvantage connected with the use of wind energy in the society of today is the poor adjustment between the demand for energy and the energy supply. This disadvantage can be overcome to a significant degree by the use of storage systems. The study of storage by means of water power is already a part of the Markerwaard and Energo projects. Not long ago the "Underground Pump Accumulation Center in the Netherlands" (OPAC) proposal, begun by Haskoning, Voker Stevin, and the Technical University of Delft, was added to these. Support to these projects will be granted within the framework of the follow-up program.

Basic Research

The developmental work in the field of wind energy should be supported by a sound knowledge of all facets that are significant for the design, construction, and use of safe and reliable wind-energy conversion systems. This basic knowledge is already available to a large extent, distributed among various branches of the Technical universities, certain TNO [Netherlands Central Organization for Applied Natural Scientific Research] institutes, the NLR [National Aeronautical and Astronautical Research Institute], and the KNMI [Royal Dutch Meteorological Institute].

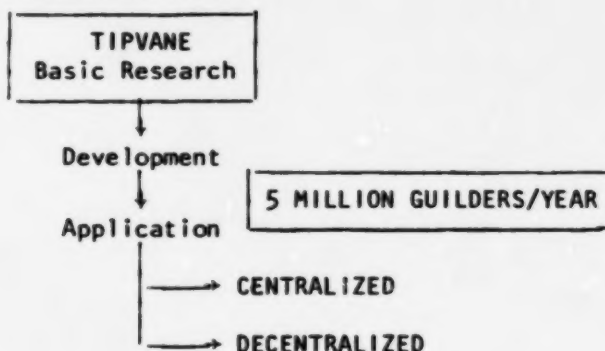
It is partly the task of the BEOP to assemble this scattered but available information in such a way that manufacturers and users of windmill installations can make optimal use of it.

There have been urgings from various quarters to establish a so-called "Wind Institute" to which all of the basic and applied research in the field of wind energy would be subordinated. The establishment of such an entirely new, independent institute with its own buildings, personnel, and wind tunnels would, however, be a costly and time-consuming affair. An alternative is to place the "Wind Institute" under the ECN [Energy Research Center of the Netherlands], making as much use as possible of the knowledge and infrastructure existing at KNMI, NLR, the technical universities, and TNO.

BASIC RESEARCH

"WIND INSTITUTE"
ECN - NLR - THD - THE - TNO - KNMI

AMOUNT AND BEHAVIOR OF WIND
AERODYNAMICS
AERO-ELASTICITY
VIBRATIONS
DESIGNS
DESIGN CRITERIA
CALCULATIONS AND MEASUREMENTS
REGULATION AND SECURITY
SUCTION EFFECTS
CONVERSION SYSTEMS
SPATIAL AND LEGAL ASPECTS



One special project is the tipvane research. The tipvane concept is in fact the only new technical "invention" in the windmill field that could mean a significant stimulus to the application of wind energy on a large scale. But the whole development is still in the research stage, and hence this subject is included in the basic research chapter. As soon as it has been shown by the experimental installation in Hoek van Holland that a considerable increase in the energy yield per m^2 of rotor surface can be achieved outside the wind tunnel, too, a start can be made with product development.

Organization, Planning, Financing

Organization

It is proposed to have all activities within the framework of the Extended National Wind Energy Research Program carried out in the same way as in the previous program. For this purpose the program is divided into component projects, the execution of which is entrusted to the firms and institutes that are best equipped and prepared to extend their cooperation for the purpose. In general an attempt is made to involve Netherlands industry as much as possible in the developmental work.

The coordination of activities again lies with the ECN's Bureau of Energy Research Projects [BEOP]. To put the BEOP in a position to be able to act purposefully and effectively, it must be given the necessary authority and responsibility.

Planning

The extended program is set up for a period of 3 years (1 January 1981 to 1 January 1984). For the small-scale projects this period is long enough to arrive at tangible results. For the big projects listed in the centralized section this period is generally too short. In 3 years' time no prototype of a big windmill (rotor diameter at least 50 meters) can be designed, built, and adequately tested. For the proposed wind installation not even the complete design can be ready by that time. Now this is not so bad in itself, since the decision to construct it will not be made until the design is completed and a reliable idea of the total costs has been obtained.

Financing

The following sources can be drawn upon for the financing of the program:

- General financing of NOW: Ministry of Economic Affairs;
- Contributions of the institutes themselves: ECN, the technical universities, TNO, and IMAG [expansion unknown];
- Contributions of industry;
- Contributions of polder boards;
- Contributions of government agencies (e.g., Ministry of Agriculture, Ministry of Science Policy, municipal administrations, etc.);
- Contributions of financing companies (NOM [expansion unknown], NEOM [Netherlands Energy Development Corporation]);
- Public credits (development, innovations, demonstration projects); and
- Public subsidies (WIR [Investment Accounting Act], energy saving, small-scale activities).

A definite policy is necessary here, as otherwise endless discussions would arise concerning who should pay what.

The estimated total costs will be:

Decentralized	1981-1984: 20 million guilders
Centralized	1981-1984: 50 million guilders
Centralized	1981-1987: 200 million guilders
Research	5 million guilders a year.

8815

CSO: 3102/405

ENERGY

FAVORABLE FINDINGS FOR SOLAR INSTALLATIONS

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 2 Sep 80 p 5

[Text] Replying to a question in the Bundestag, the government read a statement about currently available experience with solar installations in government buildings. Even if statistically conclusive statements cannot be made until after the solar installations in government buildings have been in operation for a minimum of three years, according to the government reply, on the basis of information available so far the following initial experiences can be reported:

The solar collectors are in good to satisfactory condition. Where this was not the case in individual exceptions, principally because of errors in on-site installation or product defects, the collectors have been exchanged under guarantee by the manufacturer.

The laying of pipes for the collector field has, as a rule, been carried out neatly. In a few cases, the thermal insulation for the pipes is in need of improvement.

There are hardly any complaints about the storage systems. However, the volume of the storage systems could not always be optimally designed, since structural considerations had to be taken into account.

The hookup of the solar system to the existing conventional heating and hot water system and the controls for its timing and regulation turned out extremely well. Considerable uncertainty seems to prevail among both the manufacturing and installation firms in the choice of the correct method of regulation, particularly in the case of larger installations with divided storage capacity.

The interim findings of the government, represented by the Ministry of Research, are that the so-called "growing pains" of solar installations, in the majority of cases, can be attributed to the breakdown of conventional plant components, relatively simple errors in installation and problems with regulation.

9581
CSO: 3102/412

ENERGY

EXPERIMENTAL WIND GENERATOR TO BE OPERATED IN WALES

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 2 Sep 81 p 5

[Text] The electricity generating board for England and Wales will acquire a wind-powered generator with an output of 200 kilowatts. It is to be set up on land, near the Carmarthen Bay generating station in South Wales. It will be built jointly by James Howden, Ltd. in Glasgow and the American manufacturer Wind Turbine Generators, Inc., in Buffalo, New York. The rotor will have a blade diameter of 25 meters and the hub will be at a height of 25 meters, so that the device will have a height of 37.5 meters from the ground to the blade tip. The design from Wind Turbine Generators was selected from five bids. The entire project, including recording equipment, earth moving and pouring the foundations, will cost about 5 million pounds sterling.

The operation of the wind-powered generator, whose current will be fed into the general grid through an 11-kilovolt line, will be constantly monitored to acquire data for further development work. The small "windmill" is to provide operational experience for the electricity board first, before it commissions medium-sized generators with an output of at least 1 megawatt each. The choice of some of the locations for these generators, which are being planned in groups of 10 machines, has already been narrowed down. These generators would be erected at intervals of about 800 meters. But the electricity board responsible for northern Scotland (North of Scotland Hydro Electric Board) has already ordered a 3-megawatt wind-powered generator for the Orkney Islands, which could be in operation in 1983 or 1984. This electricity board in the far north of the country already has some diesel-powered generating stations in operation on the islands, which it is trying to replace as soon as possible because of the high cost of fuel.

9581

CSO: 3102/412

ENERGY

NEW PROCESS FOR ARTIFICIAL PRODUCTION OF NATURAL GAS FROM COAL

Zurich CHEMISCHE RUNDSCHAU in German 1 Jul 81 p 10

[Text] The research work for extraction of artificial natural gas from coal has made further progress, as announced by Federal Research Minister Andreas von Buelow in Bonn. Now for the first time, artificial, i.e., synthetic, natural gas has been produced in a continuous process by the gasification of coal in a pilot plant at Oberhausen-Holten. Concerned here is a technically and economically advantageous single-step fluidized bed process. The process for converting coal into synthetic natural gas proceeds in two steps: First, raw gas (coal gas) is produced from hard or brown coal. Next, the purified coal gas is converted into methane, the main constituent of naturally occurring natural gas, by means of the so-called Thyssen gas methanation process.

The gas extracted corresponds in its heat content, its chemical composition and its combustion qualities to naturally occurring natural gas. Up to now, gas produced from coal could because of its nature only be used in industry and in chemistry. Now it has become possible in principle also to use gas from coal for public energy supply and thus also in private households.

The progress in coal gasification technology is based on the Texaco gasification process developed by Ruhrkohle AG and Ruhrchemie AG. The synthesis gas produced thereby is afterward converted to synthetic natural gas in the methanation step developed by Thyssengas GmbH and Didier Engineering GmbH. Since 1977, development of the processes has been supported with funds from the "energy research and energy technologies" programs by the Federal Ministry of Research and Technology.

5586

CSO: 3102/398

INDUSTRIAL TECHNOLOGY

INDUSTRIAL ROBOTS NOW BEING MANUFACTURED IN SPAIN

Duesseldorf VDI NACHRICHTEN in German 21 Aug 81 p 27

[Text] Not long ago the Spanish press reported with pride that the first industrial robot manufactured entirely in Spain had been delivered to Ford Espana. The Spanish group Friends of VDI investigated the report and found it only partly correct. True, the (Spanish) firm ASEA had delivered an industrial robot to Ford at Almusafes/Valencia; however, Garcia-Moton, technical director of the supplier firm in Madrid, made known upon questioning that up to 50 percent of the robot's parts were imported.

It is interesting, however, that the Spanish subsidiary of the Swedish robot giant has undertaken the series production of two types of industrial robots. These are the models designated in Sweden as IRB 6 and IRB 60 with payloads of 6 and 60 kg, respectively. The installation sold to Ford was of the latter type, weighing 750 kg. A contract for 20 to 25 units per year is anticipated; meanwhile, efforts are being made to increase the proportion of Spanish parts to about 90 percent.

The technology and several electronics components will still have to be imported. In the future Spanish technicians and engineers will take over the job-analysis task and develop the software in cooperation with the customer. After that, a positive export development is expected.

The industrial robots now being manufactured are considered primarily for production, deburring and finishing operations. Additional areas of application are presently being developed such as the application of bonding materials, loading and unloading machines, feeding injection molding processes and, above all, for welding work.

ASEA has turned to the Spanish automobile manufacturers and hopes to rein Figueruelas near Zaragoza. Spanish engineers are already being trained for this at Opel in Germany. The German branch of ASEA has finally delivered a series of robots to Opel as well as additional units to Ford, BMW and Daimler-Benz.

The Swedish parent company established the Spanish factory in 1912; in 1965, this company passed totally into the hands of the Swedes.

9160

CSO: 3102/426

SCIENCE POLICY

FINANCIAL STRAITS HELP DETERMINE NEW R&D ORIENTATIONS

Duesseldorf VDI-NACHRICHTEN in German 10 Jul 81 p 21

[Article: "New Approaches in Research Policy. Von Buelow: 'Difficult and Lengthy Reorientation'"]

[Text] Financial difficulties are expected to continue for some time to govern the research and technology policy discussion as well as the argument about such catchwords as direct/indirect support. However, gradually new approaches are also becoming apparent for a new concept of the federal government's research policy; they concern the content as well as the method of support and are to a great extent conclusions drawn from the financial bottlenecks.

The Federal Minister for Research and Technology (BMFT), Dr Andreas von Buelow, made this clear in a conversation with the Science-Economics-Policy (WWP) Information Service, in the following six points:

-- Research in the areas of environment, climate, microelectronics, biotechnology and information technology is to have priority.

-- In the future the most intelligent solution must be sought, rather than the most perfect or the most costly solution.

-- In basic research a "minimum measure of accountability to the taxpayer is absolutely necessary," resulting, therefore, in more government financial control.

-- In the heretofore neglected humanities and social sciences the laender and scientific organizations are to be responsible for capacity of "high qualitative value."

-- The large research establishments should, following the example of the Fraunhofer Society (FhG), try harder to obtain research orders. They can thus balance out personnel cuts.

-- Contact between basic research and industry must be improved; von Buelow expects concrete proposals, such as proposals from the chemical industry on the division of work between government and the economy in this area.

The federal research minister sees the requirement for economical use of money as a real chance for new emphases in research and technology policy. To be sure, this process of reorientation is very difficult and lengthy. He sees the coming discussions on the federal 1982 budget as still entirely under the heading of coping with the crisis: What is "valuable in the long term" shall as much as possible not be damaged; in places where, according to his concepts, industry must participate more actively, where the financial capacity of the federal government simply is not sufficient, and where the long-term use is not so great, the federal government wants to pull out. Still-relevant actual cases are: The German-American-Japanese project for coal liquefaction, the cabin taxi, the ZEPHYR pilot plant at the Institute for Plasma Physics, a few demonstration projects, and the planned Rheine-Freren test track for wheel-rail tests.

By means of this last example, the BMFT explains how he conceives obtaining the most "intelligent" solution with available means instead of the "best" solution: instead of building a completely new track for test purposes only, at a cost of DM 300 million, the Federal Railways could carry out the tests on their newly constructed tracks. Where public installations are concerned, the most perfect solution has always been attempted in the FRG because there was a lot of money: here rethinking is needed. For government support, von Buelow formulates: "Those who adjust most rapidly should also be helped most rapidly."

Flexibility in the Research Budget

On the subject of supporting science through increased budgetary flexibility, above all in basic research, von Buelow is very cautious. He sees the government administration's efforts to attain increased financial control and absolute transparency of the science budget as the result of certain abuses, but above all within the framework of economy considerations. The finance minister's "fair request" to want to know what he is authorizing money and jobs for should be heeded. They cannot "simply disappear in the pool without someone knowing where they later reappear." To be sure, the research minister doubts whether it is necessary to go so far as to list the projected jobs completely in the federal budget plan; it will still be necessary to wrestle over this with the finance minister and the budget committee.

The federal government vigorously supports the principle of self-administration of science. The autonomy of the German research community and the Max Planck Society must be maintained; the federal government must limit itself to creating guidelines for basic research, which itself determines its tasks and methods. To be sure, it cannot be rejected out of hand that the federal minister for research and technology--by means of financial guidelines, especially in the case of large-scale investments--can have a decisive influence on determining the main effort, e.g., in the large-scale research establishments.

"Bridging Function" of the BMFT

Von Buelow sees for his department a bridging function between parliament, government and science. Basic research has the possibility of voicing its interests through the BMFT in the political area. The other way around, the tying in of

science to the total political responsibility on the basis of an immediate relation between science and the BMFT is basically guaranteed thereby. "The uncoupling of science from general politics can lead to an isolation of science and can stir up increasing skepticism by the public toward science."

Von Buelow asked scientists to show more courage in the argument with the government administration. "Many professors have no idea how budget plans are arrived at and are then surprised when they think that they have been completely raked over the coals by government officials." Scientists must become more familiar with budgetary questions and must also in their own committees not simply accept everything but instead resist those who interpret laws bureaucratically.

Von Buelow assigns special weight to strengthening the humanities and social sciences. He says that we should not allow ourselves to be discouraged by the closing down of the Max Planck Institute for the Social Sciences, and that reverses occur, in part because the desired quality was not attained. The Max Planck Society should make a new approach in sociology. Incidentally, the federal research minister sees the laender and the German research community above all as responsible for supporting the humanities and the social sciences. The Science Center in Berlin, which is under the responsibility of the federal government, is not to be extended beyond present plans for now, but is instead to be consolidated first.

In the area of large research establishments, care must be taken that these not carry out a catchall of the smallest projects, but also do basic research. The multidisciplinary research potential available there should--especially when the center undertakes new tasks--also be put at the disposal of regional technological development. Small and medium-sized enterprises should be able to take advantage of the know-how available there. The Fraunhofer Society has developed very well with this orientation. Large research establishments should also go in this direction. Von Buelow referred to the 1.5 percent annual cuts in the personnel of large research establishments which he is demanding over the next 5 years as a "very moderate" pace, which, however, could also be shortened to 3 years. He is now awaiting proposals from the centers.

Fraunhofer Society Is an Example

They will, however, also be given the possibility of soliciting additional orders from the economy, following the Fraunhofer Society's example, in order to hold onto their personnel. A few centers have always done contract research.

The federal research minister was very critical of the chemical industry's conduct. The fact that Hoechst AG has invested millions for basic research in an American and not in a German research establishment disappoints him very much, as does the restraint shown thus far by the industry toward considering the founding of a Max Planck institute for polymer research.

Von Buelow expects neither general criticism nor surprising actions but instead concrete proposals by the chemical industry on a possible division of work in research.

Entwicklung des Haushaltsplans des Bundes 1)
Einzelplan 30 (BMFT), ausgewählte Programmbereiche in Millionen DM (Stand 27. 2. 1981) 2)

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
3) IST	IST	IST	IST	IST	IST	IST	Entwurf 4)	BMFT-Anforderungen 5)			
BMFT-Haushalt 6)	4114	4021	4206	4702	5063	5722	6140	6870	7213	7524	7762
Steigerung gegenüber Vorjahr (v. H.) 7)		- 2,3	+ 4,7	+ 11,7	+ 18,3	+ 2,9	+ 7,3	+ 11,9	+ 5,0	+ 4,3	+ 3,2
Physikalisch-chemische Grundlagenforschung *) 8)	392	405	408	463	482	515	528	584	636	694	774
Anteil am Einzelplan (v. H.) 9)	9,5	10,1	9,7	9,9	8,7	9,0	8,6	8,5	8,8	9,2	10,0
Steigerung gegenüber Vorjahr (v. H.) 7)		+ 3,3	+ 0,7	+ 13,5	+ 4,1	+ 6,8	+ 2,5	+ 10,6	+ 8,9	+ 9,1	+ 11,5
MPG (Betrieb und Investitionen) einschl. 10)	270	269	284	307	319	335	359	374	386	406	432
Sonderfinanzierung Anteil an Einzelplan (v. H.) 9)	6,6	6,7	6,7	6,5	5,7	5,9	5,8	5,4	5,4	5,4	5,6
Steigerung gegenüber Vorjahr (v. H.) 7)		- 1,1	+ 5,6	+ 8,1	+ 3,9	+ 5,0	+ 7,2	+ 4,2	+ 3,2	+ 5,2	+ 6,4

*) darin enthalten: Zentren: DESY, GSI, HMI, Beiträge an CERN, ILL, ISAS, 685 01, 893 01, und Zusammenarbeit mit ausländischen Forschungsinstituten. 11)
Quelle: BMFT (DAFIN) 12)

Key:

1. Development of the Budgetary Plan of the Federal Government
2. Individual Plan 30 (BMFT), Selected Program Areas in millions of DM (as of 27 February 1981)
3. IST [actual figures]
4. Projected
5. BMFT Requests
6. BMFT budget
7. Increase in comparison with previous year(%)
8. Physical-chemical basic research*
9. Participation in the individual plan (%)
10. MPG [Max Planck Society] (operation and investments) including special financing
11. *Contained therein: Centers: DESY, GSI, HMI, contributions to CERN, ILL, ISAS, 685 01, 893 01, and collaboration with foreign research institutes.
12. Source: BMFT (DAFIN)

5586

CSO: 3102/398

SCIENCE POLICY

POWERS OF RESEARCH MINISTRY MADE OFFICIAL

Paris AFP SCIENCES in French 30 Jul 81 pp 1-2

[Article: "Powers of the Research and Technology Ministry"]

[Text] Paris--The order assigning powers to the Minister of Research & Technology appeared in the 30 July issue of the official gazette.

The writing of this order posed some problems in the division of powers among several ministries, especially the Ministry of Industry, insofar as some agencies--such as the Atomic Energy Commission or the National Center for Space Studies, to name just two examples, which previously were entirely subordinate to the Ministry of Industry--not only do basic research, but even own subsidiaries for industrial production.

The order gives broad powers to the Research Ministry, while making every effort to include the flexibility necessary for well-coordinated public research.

The five articles of the order are as follows:

1. The Ministry of Research & Technology has the power to propose and, in conjunction with the other ministers involved, to implement national policy in the domain of research and technology.

He has authority over the General Delegation for Scientific and Technical Research [DGRST] and the Interministerial Mission for the Development of Scientific and Technical Information [MIDIST].

In matters of industrial and technological research he exercises the powers previously conferred upon the Minister of Industry by order No 78-593 of 16 May 1978. The Delegation for Innovation and Technology and ANVAR are placed, in so far as necessary, under the control of the Minister of Industry.

2. He prepares government decisions concerning allocation of resources and funds allocated by the government to civil research and development activities, namely grants to public institutions and other public technological research and development agencies. Funds earmarked for these institutions and agencies (except universities) are included in the budget of the Ministry of Research and Technology.

Concerning public institutions and other public research agencies, the Research Minister, in conjunction with the other ministers involved, is charged with the preparation and implementation of all reforms concerning their organization, personnel regulations, and all actions affecting scientific employment policy. He countersigns the supporting documents in these areas.

He must be consulted about the research programs of national corporations.

3. As regards the CNRS [National Center for Scientific Research], the Minister of Research and Technology exercises the powers previously reserved to the minister in charge of universities.

4. The Minister of Research and Technology is a party to /cooperative international scientific/ [passage enclosed in slantlines underlined in source] actions. In conjunction with the Minister of External Relations, he follows and coordinates the actions taken in this domain by the research agencies.

5. According to their involvement, the Prime Minister, the Minister of State, Minister of Research and Technology, Minister of External Relations, Minister of National Education and Minister of Industry are each charged with executing this present order.

On 23 July, Jean-Pierre Chevenement held a lengthy meeting with the directors of most of the research agencies, including those of the ONERA [National Office for Aerospace Studies and Research] and the CNET [National Center for Telecommunications Studies]. The ONERA and CNET budgets are not included in the budgetary package of the Ministry of Research and Technology.

The agencies represented at the meeting were as follows:

CNRS [National Center for Scientific Research]
ANVAR [National Agency for the Valorisation of Research]
DIT [Delegation for Innovation and Technology]
MIDIST [Interministerial Mission on Scientific and Technical Information]
ORSTOM [Bureau of Overseas Scientific and Technical Research]
INRA [French Institute for Agronomical Research]
INSERM [National Institute for Health and Medical Research]
GERDAT [expansion unknown]
CEA [AEC]
COMES [Solar Energy Commission]
CNEXO [National Center for Exploitation of the Oceans]
INRIA [National Institute of Data Processing and Automation Research--Rocquencourt]
Pasteur Institute
ADI [Data Processing Agency]
IRCHA [French Institute of Applied Chemistry Research]
BRGM [Bureau of Geological and Mining Exploration]

During this meeting, there was a lengthy discussion of the national research symposium to be held next January with a view to preparation of the five-year plan

for research. The minister asked the agencies to participate extensively in this symposium. Recalling the personnel relations problems in the agencies, Chevenment hoped that action would be taken in the areas of large-scale cooperation, democratization and good circulation of information.

The question of scientific and technical information, and the problem of data bases and data banks are of particular concern to the minister, who intends to initiate actions in these areas. He considers it necessary to develop the communication between the scientific community and the public. Chevenment asked the directors of the agencies to be more open with the press. The minister concluded with his concern for the preservation of the French language on the plane of international scientific relations.

Finally, regarding preparation of the 1982 budget, it was indicated that Chevenment stressed that "it is along the line of 2.5%," meaning that it constitutes the first stage in the national research effort to attain this percentage with respect to the gross national product in about 1985.

9171

CSO: 3102/410

SCIENCE POLICY

RECENT AID TO INNOVATION SHOWS LARGE INCREASE

Paris AFP SCIENCES in French 30 Jul 81 pp 11-12

[Article: "An evaluation of ANVAR activities presented to Chevenement"; passages enclosed in slantlines underlined in source]

[Text] Paris--On 22 July, Jean-Pierre Chevenement, Minister of Research and Technology visited the main office of the National Agency for the Valorisation of Research [ANVAR].

Accompanied by members of his cabinet, Chevenement was welcomed by Claude Pierre, president of the administrative council, and by Christian Marbach, general director of ANVAR. During a meeting, Chevenement had the opportunity to have shown to him the organization and activities of ANVAR, particularly those of the first half of 1981.

On this point, it was stressed that the rate of ANVAR activity, profoundly transformed in 1980 (the first full year after the reform of July 1979) remained at a high level the first half of 1981.

Aid to innovation, the object of which is to promote innovation and technological progress at all stages of the innovation process, represents the most significant budget item. In 1980, ANVAR received about 1,490 requests for aid to innovation and accepted 1,047 requests, for a sum total of 547 million francs.

During the first half of 1981, 973 requests for aid to innovation were presented to the commission; 691 were accepted, for a sum total of 322 million francs. These figures clearly reveal the increase in volume from one year to the next, both in number of requests and total aid, which shows the undeniable success of this procedure. At the end of July 1981, the total should exceed 400 million francs. Taking into account this total and the requests being processed, it can be predicted right now that the sum total of aid to innovation granted in 1981 should equal about 550 million francs, which will be made possible thanks to the additional 60 million francs in the total budget, which will complete the existing grants.

The main office made 97 grants for a total of 175 million francs, and the regional offices made 594 grants for a total of 147 million francs. The grants which represent an average 33 percent of the innovation programs planned by the

beneficiaries (45 percent in district offices) are generally advances, repayable in case of success.

This distribution of decision-making among the main office and district offices is to evolve towards greater regionalization, since from 1 July the regional representatives of ANVAR can grant aid up to 1 million francs, where they were previously limited to 500,000 francs.

The regions most benefiting from the aid to innovation granted by the regional representatives are Rhone-Alps, which will receive the second meeting of ANVAR in Lyon next 15 and 16 October, then Ile-de-France, the Loire region and Nord-Pas-de-Calais.

The allocation of subsidies for innovation, the object of which is to encourage to PME [Small and Medium-Sized Businesses] to subcontract their research work to approved agencies or experts, progressed at an even more significant rate, partly due to the recent extension of its field of application, but also especially because this procedure is becoming better known by the businesses. Thus, while in 1980 ANVAR granted 1,756 subsidies for a sum of 12.8 million francs, 1,134 subsidies were paid or were in the process of being paid, by 30 June 1981, for a sum of 11.7 million francs.

In almost all the cases, the subsidies were granted by regional representatives of ANVAR, and the allocation procedure takes several days (the procedural delay being 2 to 4 months for aid to innovation). About 50 percent of the total innovation subsidies goes to the Ile-de-France region.

The district representatives of ANVAR, who are handling an increasingly more significant proportion of aid and subsidies for businesses, are likewise in the process of developing their services designed for the research agencies and regional laboratories.

The whole of these activities necessitates significant reinforcement of their personnel and equipment, which will be accomplished in 1981 and 1982, thanks to corresponding budget allocations.

Aid to Innovation (1 Jan to 30 Jun 81)

<u>Item</u>	<u>Main Office</u>	<u>District Offices*</u>	<u>Total</u>
Number of requests registered with ANVAR	197	783	980
Number of requests submitted to the commission	185	788	973
Number of requests deferred	20	82	102
Number of requests settled	165	706	871
Number of files closed	13	-	13
Number of requests refused	51	112	163
Number of requests accepted	97	594	691
Total sum accepted	175,330,000	147,089,894	322,419,894

*Interim figures

9171

CSO: 3102/410

FOUR PROTOTYPES OF 'AUTO 2000' INTRODUCED

Frankfurt/Main FRANKFURTER ALLGEMEINE in German 15 Sep 81 pp 9-10

[Article by Gerold Lingnau: "How The Automobile Could Look in The Year 2000"]

[Text] What will the automobile look like in the year 2000? That cannot be known exactly. But attempts can be made to anticipate it according to the state of technology today, even to construct it in advance. This is a fascinating problem for engineers. So there was some interest shown in the automobile industry, when the Minister of Research--at that time still Volker Hauff--gave the impetus in 1978 for the research project "Auto 2000" and promised to make subsidies available. Four competitors were finally left: Daimler-Benz, Audi NSU, Volkswagen and a work group from university institutes in Aachen, Berlin, Darmstadt and Stuttgart, headed by Professor Breuer in Darmstadt. All of them had to realize their ideas for the car of the future on a very short schedule. Now, just a few days before the opening of the Frankfurt Auto Show, the four prototypes were introduced.

The "Demonstration of the Results of Automotive Technology Research in Integrated Total Concepts of Experimental Passenger Models," as the "Auto 2000" project is called officially, was to cover three principal areas: Energy conservation, environmental protection (less noise and exhaust gases) and safety. Accordingly, the parameters in the specifications were formulated and set out so that no one of the three lines of development should have precedence over the others--and at the expense of the others. The finished designs should be suitable for everyday use, so that they can be adapted for series production without great difficulty--which does not mean that the prototypes would have to be forerunners of production cars in the form presented.

The automobile presented by Audi NSU is the closest to a present-day middle-class car, even in its external shape. The five-seater of impressive size is far more streamlined than today's Audi, its coefficient of drag of 0.30 is 25 percent lower than is normal today. It was achieved by a great deal of detail work, for example, windows fitted flush to the body. The car's roof and smooth floor are of lightweight sandwich construction bonded to the steel load-bearing body structure. Airbags and a child's seat integral with the back seat contribute to occupant protection. A gasoline engine with a turbocharger, tuned for greatest economy, drives the front wheels; it is so effectively soundproofed that road noise is determined only by tire noise.

Daimler-Benz also decided to build a large, comfortable prototype which is equipped with all luxury-car extras. They wanted to show that a long-distance car of this type, for which there will be a demand even in the future, can make do with low fuel consumption. Of the three power plant variations envisioned--a gas turbine with highly developed ceramic components, an 8-cylinder gasoline engine with reduced power and cylinder cutout in part-load operation and a 6-cylinder diesel with two exhaust-driven turbochargers in series--only the diesel has so far become a reality in the prototype; it too is in a noise-tight compartment. The automatic transmission can be programmed: The driver has the choice between "Economy," "City" (specially quiet) and "Fast." Like the Audi, the Mercedes of the future also has a "soft" nose section of plastic for better pedestrian protection in accidents. An information system transmits all important data to the driver. An antilocking system for the brakes, distance warning system and a device that prevents wheelspin during acceleration complete the prototype, which, with its extended tail, has a drag coefficient of less than 0.3.

The university work group placed importance on accident protection for pedestrians and bicyclists in their development. All the areas on their prototype that could be involved in the event of an accident are padded and smoothly shaped. Additional measures were directed at safety in side collisions. The car is a four-door station wagon with front-wheel drive, its drag coefficient is less than 0.25. The power plant is a diesel engine with direct fuel injection and a turbocharger, which was developed by MAN [Maschinenfabrik-Augsburg-Nuernberg] on a Citroen engine block. It is coupled to an infinitely variable mechanical automatic transmission with electronic control. The car also uses a driver information system. Fuel consumption is said to be only 6.6 liters/100 km, with totally competitive middle-class performance.

Volkswagen contributed the only smaller car to the four. Its interior space is larger than in the VW Rabbit but smaller than in the Dasher. With a drag coefficient of 0.25, this sedan is also extremely aerodynamic (Rabbit: 0.42). The bodywork uses a great deal of aluminum and plastics. The driver is extensively supported by electronics: Not only for information (digital displays on the instrument panel), but also in controlling heating and ventilation (by microprocessor) and in the activation of the "automatic device for utilization of inertial energy" (the engine is automatically switched off when the car stops and then started again by the flywheel which continues to spin). A 3-cylinder diesel engine with direct injection and a turbocharger--consumption about 4 liters/100 km--or a turbocharged gasoline engine are under consideration as possible motors, both of them in noise-tight compartments.

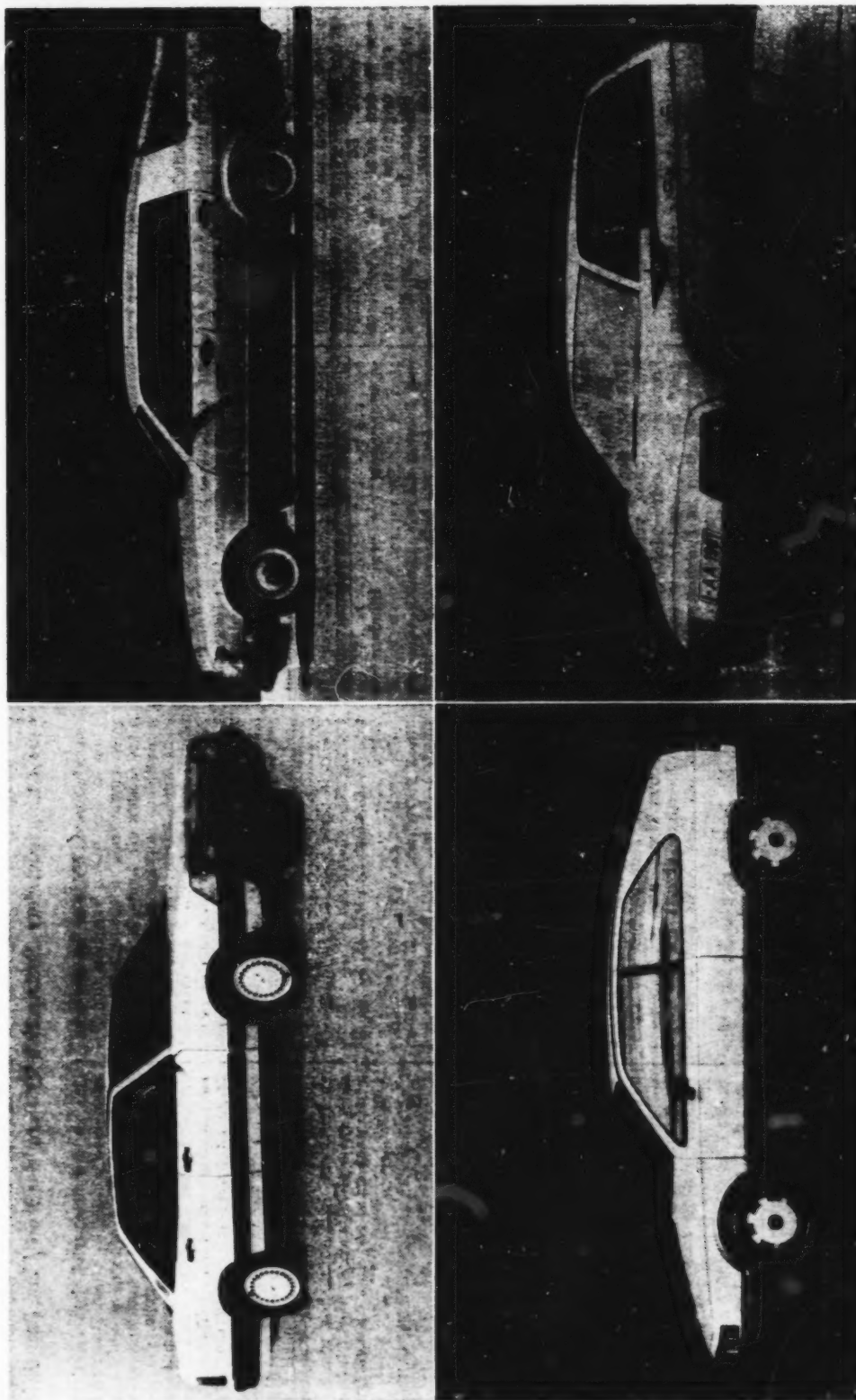
When could the prototypes become real automobiles? Even if they were intended to be (which they are not), at least 8 to 10 years would be required--even in the case of the one closest to production status--the Audi. Many manufacturing problems would have to be solved, large parts of the planned electronics systems are still untested and enclosing the engine still has hidden problems (danger of overheating). But individual components of these cars of the future could be used earlier in series production. One must look at the prototypes from this perspective, as they are now being introduced in Frankfurt.

However, what was supposed to be celebrated here as an important way station along an interesting path, turned into political discord. Surprising everyone, Minister of Research Andreas von Buelow told the chief engineers of the three automobile companies present that he could not provide money for the impending test phase of the prototypes: Only the university group would continue to receive subsidies. The budget cuts that were being asked of him could not be managed in any other way. Why Buelow kept back this surprise--which sets at naught all promises and contracts--for the official introduction could not be fathomed. In any event, the three board members, Professor Fiala (VW), Professor Breitschwerdt (Daimler-Benz) and Piech (Audi NSU) heard of it for the first time on this occasion. They expressed their disappointment plainly. It was not so much a matter of the money: The prototypes would not remain "research ruins," because the companies would test them on their own--although perhaps not as extensively as planned earlier. It was painful to discover how projects designed for the long term were being abruptly terminated by one side. The relationship of trust between the giver and the receivers of subsidies was being jeopardized for the future.

Those critics who had doubted from the outset the need for government financial assistance for a project like this should be satisfied with the end of the affair. In their opinion, the automobile industry would have started the same developments without assistance from Bonn--in fact, they would have been forced to. That is not true either: The prototypes show that the designers could get a little farther away from immediately realizing their ideas during the design stage, thanks to the subsidies. That means: They could "fantasize" a little more than usual. And that could only help the bounty of ideas for the "Auto 2000."

9581
CSO: 3102/432

END



Four versions of the "Auto 2000": Audi (top left), Mercedes (top right), VW (bottom left) and the design of a university work group.

JPRS 79282

23 October 1981

West Europe Report

SCIENCE AND TECHNOLOGY

No. 80



FOREIGN BROADCAST INFORMATION SERVICE

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23 October 1981

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CHEMICALS

ORGANIC METAL SUPERCONDUCTIVE AT ATMOSPHERIC PRESSURE

Paris SCIENCES & AVENIR in French Aug 83 p 5

[Text] Danish researchers have just formed an organic metal that is unique in that it is superconductive at atmospheric pressure. Up to now, synthesized metals have required an enormous pressure, equal to several thousand atmospheres, to become superconductive. Pressure was required to ensure a closer bond between molecules in organic compositions that became crystallized in long juxtaposed molecular chains, and to facilitate molecular mobility, thus ensuring superconductivity (see SCIENCES & AVENIR, No. 371 and No. 397).

The new composition uses a TMTSF (tetra methyltetrafulvalene) molecular base which is able to lose electrons easily. The electron is replaced by a positive ion and mobile electrons. Since the end of 1979, this molecule has been used in the synthesis of TMTSF-PF₆, in which the negative ion of hexafluoro-phosphate is stabilized by a positive TMTSF ion. This crystal is superconductive at a temperature below 1 K under a pressure of 12,000 atmospheres.

Since this synthesis, Danish researchers, in collaboration with the Orsay solid physics laboratory, have come around, little by little, to the idea that a negative ion that is smaller than PF₆ might produce the same effect as a very high atmospheric pressure, i.e., it would ensure a closer bond among TMTSF molecules.

This is why the physicists have turned to the ClO₄ negative ion that is smaller than PF₆. The resulting compound, (TMTSF)₂ ClO₄, offers zero resistance at a temperature below 1 K at normal atmospheric pressure. While being very close to the outcome of this research, it must be said that the researchers are on the lookout for a synthesis of superconductive metals at much higher temperatures of either 40 or 30 K.

According to Michel Ribault "it is fine that d'Orsay has broken away from pressure; however, the real achievement we expect to realize one of these days is to succeed in saying on degrees close to absolute zero, which are very expensive."

9766

CSO: 3102/417

ELECTRONICS

NORWEGIAN MINICOMPUTER BREAKS U.S. 'QUASI-MONOPOLY'

Paris L'USINE NOUVELLE in French 17 Sep 81 p 66

[Article by Jacques Antoine]

[Text] Norsk-Data, first European manufacturer in the 32-bit mini-computer market. To strengthen its presence on the Continent, the Norwegian manufacturer has entrusted a leading role to its French subsidiary.

In the mini-computer area, the quasi-monopoly held until now by American companies, has just been broken.

Broken by a Norwegian company: Norsk-Data. Still small compared to the large European manufacturers who have often been the center of attention (CII-HB, Philips, Siemens, or ICL, for instance), this company known mostly within scientific and industrial circles, has sailed with the wind and maintained its growth above 40 percent per year. Quite a performance.

Their driving force: the super-mini ND 500. This versatile machine, officially presented in Oslo last week by Rolf Skar, president of Norsk-Data AS, claims a performance at least 20 percent better than the current best (Vax 11/780, Data General MV/8000, PE 3240, and so on).

With this strength, the Nord line (10, 100, 100CE, and 500) expects to have "an even stronger European future," states Rolf Skar. Under these conditions, the French subsidiary established in 1975 (the largest in Europe) is expected to play the largest role outside of the Scandinavian countries. "We are already integrating software and hardware," explains Ove Lange, director of Norsk-Data France. "We have just gone further with our development activities: we have planned to manufacture in France, computers which would be covered by an European Community label".

The French are also involved on the supplier side. Since May 1981, Matra has become third source (next to the Americans and the Japanese) to supply (30 percent) multilayer circuits. "It is not out the question for Matra to become first source. Its work is of the best quality, our software is simplified, and Matra, unlike the Americans, can eventually supply other components," explains Ove Lange. Not to mention that Matra is a potential customer (OEM) for Norsk-Data computers!

The French connection is even more active. On one hand, discussions have been held in recent months with Thomson-CSF ("The idea of a joint subsidiary has not been discarded," discloses Rolf Skar. But even though each of the lines is complementary, "matters is at a standstill.") On the other hand, contacts are also expected with Efcis to supply components.

11,023

CSO: 3102/435

ELECTRONICS

LSI DESIGN CENTER: CUSTOM COMPUTERS, ADVANCED CIRCUIT DESIGN

Stockholm NY TEKNIK in Swedish 13 Aug 81 pp 6-7

[Article by Anders Wallerius]

[Text] Tailor-made computers and advanced circuit design will be Sweden's ticket into the rapidly advancing world of electronics.

LSI Design Center in Linköping will provide the expertise. What will become the center of Swedish circuit design has been built up for the past year at the Technical University.

The large computers and multi-purpose microprocessors of today will be replaced in the future by specially constructed circuits in which the program is no longer software, but is built into the circuits themselves. A completely new design philosophy may be discerned.

"Progress in this field is just beginning," said Harold Lawson, professor of computer design and head of the LSI Design Center.

"Semiconductor physics is already well known. New discoveries require enormous expenditures. That is not for Sweden."

"The same is true of production technology. There are large plants in Japan and the United States with well functioning production processes."

"We should also forget about designing simple circuits and logic," Harold Lawson said. "Such circuits may be bought from large manufacturers at a low cost."

Custom Computers

Methods of systems and computer design, on the other hand, are a wide open field. The Americans and Japanese are even with us in these areas.

For this reason, LSI Design Center will concentrate on these areas. Tailor-made computers may be the niche the Swedish computer industry needs to survive, Harold Lawson believes.

"Manufacturers of large computers are not interested in this type of computer. It is outside the scope of their organization. They prefer to work with the large multi-purpose products with many areas of application."

The field seems to be wide open for investments in advanced LSI design and the LSI Design Center in Linköping has entered this field. It has established four partial goals for its activity:

Own Language

To construct everything from entire systems to completed production techniques for both the technical university and other organizations. Local industry will also be permitted to participate.

To develop systems and methods for circuitry design. This includes everything from developing a "language" for the designer to equipment for design and circuit simulation.

To train students at the university in the new design philosophy. This includes both technicians and doctoral students. Courses will also be held for industry people and public employees.

To cooperate with other institutions, organizations, and companies that are already familiar with or wish to learn about the new LSI technology.

The First Chip

The first "real circuit" designed at the center was recently returned from the manufacturer, Hughes, in Scotland. It was a very fast "digital wave filter" (1.1 MHz) which, among other things, can be used in digital telephone systems. The filter allows signals of a certain frequency to pass and excludes other signals.

The positive feature of a digital wave filter is that it simulates a passive, analog filter. Because of this, the filter is very unsusceptible to interference. Other types of digital filters are more sensitive to coefficients, cause more noise, and can experience self-oscillation.

Industry Welcome

The center will also assist outside organizations by developing special circuits. Regional industry is welcome to use our services, Harold Lawson said:

"That could improve the existing industry and perhaps create an entirely new industry in the region."

The design work can be done quite easily with CAD (computer-aided design). Thus, one of the main tasks of the center is to develop an effective CAD system. What is needed is a "language" to describe the circuits and a library with the most used circuits.

"CAD is necessary so that the tailor-made circuits will be economically feasible," Harold Lawson said. The present system has many shortcomings, however.

Simulation Takes Time

The shortcomings are also great when it comes to equipment for simulating advanced circuits. Simulation is an important part in designing custom circuits.

The large, "normal" computers are now used for simulation. They think too much and in much too complicated ways to be suitable. When large quantities of data must be processed, as in simulation, shortcuts must be built into the equipment. It would then be much faster than with today's general-purpose computers.

"The large company Intel recently tested its new microprocessor. Some of the world's largest computers were used to assist the researchers. Still it took over 10 hours of operation to simulate 1 second of the microprocessor's operation.

This would be just the place for a tailor-made simulation computer. The center wants to develop this type of system--processors that can handle large quantities of data without needing the reserves of the large computers.

So far the personnel at LSI Design Center has been busy enough training itself. This past year was spent giving direction to the center's work. Eventually, however, technicians and research students as well as industrial employees will learn from the center's experience.

Several research students have already attempted to make custom LSI circuits. Soon the first MPC (multi-project chip) will be returned from Asea-Hafo.

Twelve different circuit designs are together on a surface of 10 x 10 mm on the chip. What distinguishes these chips is simply the connections between the chip and the pins.

The advantage of the MPC is that each circuit costs only 6,000 to 7,000 kronor to manufacture, compared to ten times that price if they are produced separately.

This fall technology students in the Y-course of study (technical physics and electro-technology) will make a "multi-project chip" as part of their instruction.

Japanese Simulation

In the area of the development of simulation and CAD systems, the center is working together with Saab-Scania and L M Ericsson, among others.

Cooperation across national boundaries is also needed, however, especially when it comes to production technology, which Sweden lacks.

Together with the Japanese, who can manufacture circuits, but are poor in the area of design, Swedish (and European) industry should hold its own in competition with the United States.

Early next year the first Japanese will probably come to LSI Design Center in Linköping. He is an expert in simulation and will remain at the center for 2 years. That is a good beginning for contacts between Sweden and Japan.

"If we are to keep up with developments, industry must wake up and see what is happening," Harold Lawson said.

ELECTRONICS

RESEARCHERS WORK WITH GALLIUM ARSENIDE FOR FASTER CIRCUITS

Stockholm NY TEKNIK in Swedish 27 Aug 81 pp 10-11

[Article by Ulla Karlsson]

[Text] The search for material that can replace silicon in the production of integrated circuits is underway around the world. A large portion of the research today is centered around the semiconductor gallium arsenide. In Sweden this is occurring at the Institute of Solid State Physics at the Technical University of Lund.

The electronic circuits of today are manufactured on plates of semiconducting material—material that can be classified neither as conductors nor insulators. The most widely used material today is silicon. During the past 10 years the components of which the silicon circuits are constructed have been made smaller and smaller.

The result has been more and more complex and faster circuits. However, the miniaturization of components cannot continue without limit. Purely physical limitations will slow developments. To continue developing the extremely fast and compact circuits necessary, among other things, for the further development of speech and picture analysis with computers, research is underway throughout the world to find new materials.

Material Research

At the Institute of Solid State Physics in Lund scientists have been conducting material research for 15 years. They are currently concentrating on compounds of elements in groups III and V of the periodic table. These include aluminum, gallium, indium, phosphorus, arsenic, and antimony.

For the past year a computer controlled device has been used to produce the various compounds. It is a so-called MOCVD, an abbreviation for Metal Organic Chemical Vapor Deposition. Machines operating in the same manner are used at research laboratories around the world. These are devices produced by the companies that use them, however. The equipment at the institute is unique in that it is the only machine in operation that was purchased.

Right Composition

When a compound is to be made in the machine the researchers punch in on a keyboard the composition they want the compound to have. A computer in the system then

controls valves and flow meters so that the correct quantity of the right gases flows into the cell of the apparatus. The cell contains a substrate on which the new compound crystallizes. So far the researchers have used only a substrate of the semiconductor gallium arsenide, but other semiconductors may also be used. Gallium arsenide is a material that has been much discussed in recent years. Among other things, an electron mobility five times greater than silicon has been attributed to the material. This means that gallium arsenide may compete seriously with silicon, especially for fast circuits.

"Gallium arsenide could be the right new material, but there are also other candidates, for example gallium indium arsenide," said Herman Grimmeiss, professor at the institute.

Impurity Atoms

The conductivity of the compounds being formed can also be altered in the computer-controlled device. This is done by adding very low concentrations of foreign atoms--impurities (approximately one impurity atom per million atoms of the material itself). The compound is said to be doped. The type of impurity determines whether electrons or "holes" will act as the charge carrier in the material (n- or p-doping).

The doped or undoped compound later removed from the device is thoroughly examined. The researchers make sure, for example, that the compound has the composition they had decided on. The verification is made by X-ray analysis. The electrical properties of the compound are then altered. This is done by adding other types of impurities. These impurities, for example copper, diffuse into the material where they produce extra energy levels.

Deep Levels

"We have specialized in so-called deep levels in the material*," Herman Grimmeiss said. These are energy levels that are far from both the conduction band and the valence band.

"By studying the deep levels we obtain an extremely precise picture of the compound's properties. In this way, we can also say which materials are best suited for a certain application."

*A perfect semiconductor consists of a large number of identical atoms. A semiconductor contains no discrete energy levels, but the energy levels have been broadened into bands. When electrons in the material are in their ground state they are in the valence band. If they are excited to a higher level, however, they enter the conduction band. If a crystal atom is replaced by a foreign atom, an extra energy level appears in the otherwise empty band gap between the conduction band and the valence band. If the foreign atom is similar to the crystal's own atoms the extra energy level appears near the edge of the band--this is called a ground level. If, however, the foreign atom is unlike the crystal's own atoms, the extra energy level is far from both the valence and the conduction bands. A deep level has been formed. Gold atoms in silicon, for example, cause deep levels.

The researchers at the institute also accept outside assignments. For example, a company might wish to produce a component with certain definite properties. Hundreds of trials may be needed to achieve the correct combination of materials.

Individual components of the tailor-made material are produced, while large-scale production is left to the company that ordered the component. This type of cooperation currently exists with the Microwave Institute in Stockholm.

Specific Performance Characteristics

Swedish industry should be able to use our knowledge of materials to produce somewhat exotic components with very specific performance characteristics. Advanced systems could then be constructed around these components.

"Today Swedish systems are often constructed around imported components, but foreign manufacturers cannot begin to sell their components until they have an overproduction, i.e., 3 to 4 years after the component has been produced. This often means that our systems are already "old" when they have been fully developed."

"For companies that produce circuits, we can also tell which material is the most promising. In this way, wasted investments can be avoided."

The New Semiconductors Are Produced In This Way

The new semiconducting material is made in a computer-controlled system called an MOCVD--metal organic chemical vapor deposition.

A new compound is made in the following manner:

The system has seven containers with various liquids and gases. Three of the containers have liquid substances from group III of the periodic table. They might be, for example, trimethyl gallium, trimethyl aluminum, and trimethyl indium. Two containers have substances from group V, for example the poisonous gases arsine and phosphine, while the other two contain doping substances.

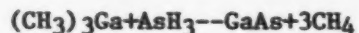
Hydrogen Gas Flows

When a semiconducting compound is to be made, the researchers allow hydrogen gas to flow in the system. The flow rate is about 4 liters per minute. The hydrogen gas is allowed to pass through the container with the group III substance that is to be included in the compound--for example, trimethyl gallium $(\text{CH}_3)_3\text{Ga}$. The hydrogen gas is mixed with the trimethyl gallium and a computer-controlled flow meter makes sure the correct quantity of gas passes into the so-called reaction cell.

At the same time, a valve opens to the container with the group V substance that has been chosen, for example arsine, AsH_3 . The arsine also flows into the cell.

The cell contains a substrate on which the compound will crystallize. So far only gallium arsenide has been used, but other materials may also be used.

The temperature in the cell is 600 to 700°C when an epitaxial layer of the new compound grows on the substrate. In the present example, the result is a very thin layer of gallium arsenide--GaAs. The reaction occurring is:



The only residual product formed is methane.

Doping Substances

If the semiconducting compound formed is also to be doped, a valve to one of the two containers with the doping substances is opened. The one that is opened depends on whether the researchers want electrons or "holes" to function as the current carries in the material (n- or p-doping). Hydrogen sulfide, H_2S , is used for n-doping and dimethyl zinc for p-doping.

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CSO: 3102/424

'THEK' PROGRAM: RESEARCH IN SOLAR, THERMAL ENERGY

Aix-en-Provence REVUE INTERNATIONALE D'HELIOTECHNIQUE in French 1st half-year 81
pp 4-7

[Text] ABSTRACT.--The following paper presents information about the work carried out at the Marseilles Department d'Heliophysique and concerning the THEK [Kilowatt Thermo Helio Electric Plant] program developed by the French CNRS [National Center for Scientific Research].

This program includes a feasibility study of solar/thermal energy stations in the range of a few thermal megawatts of energy produced.

These units, based on the distribution collector concept, use modular converters designed to concentrate the collected solar radiation onto an absorber from which the heat produced is extracted using an organic fluid operating at up to 300°C. The concentration ratio, obtained by approximating a paraboloid to flat-facetted mirrors, is in the range of 230 and allows efficiencies above .70 with a black absorbing surface.

After designing and testing two prototypes of this converter (50 m² collecting area), an industrial production of a few tens was started, four of which are being tested at the present time.

Two pilot plants in the range of .3 to .5 thMW are to be built, one will deliver heat at 300°C to be used in a thermodynamic loop for production of electricity, the other producing steam at 180°C/10 bars for industrial use (desalinization, drying, heating, etc.)

I. Introduction

The experimental work carried out at the Marseilles "Department d'Heliophysique" within the scope of the "THEK" program and concerning solar/thermal conversion modules has confirmed the predictions made at the inception of the project.¹

The objective of the "THEK"* project is to open the way for the development of devices for the conversion of solar energy into energy usable in the "medium power" range. The preliminary studies have led to the selection of a modular system (sometimes designated "distributed converter") using concentrated solar rays prior to thermal conversion; both operations being performed within the same module. The heat is then carried by a collector network interconnecting the modules and is regulated before distribution, either directly in the form of heat, or after secondary transformation, in the form of mechanical, electrical, or other energy.

The project includes three phases:

- THEK 1: Definition, design and experimentation using one or several prototypes of the solar converter module;
- THEK 2: Industrial production of modules, study, implementation, and experimentation of a collection and regulation network;
- THEK 3: Adaptation of THEK units to a specific use.

The following will give an idea of the status of the project, started in 1975, and which is currently in the following stage:

- THEK 1: Completed;
- THEK 2: Study completed; preproduction phase in progress; implementation of the network in progress;
- THEK 3: Study in progress.

We should mention that this activity, which was initially strictly a research project, is now supported by the French Solar Energy Commission (COMES) which is financing the experimental industrial predevelopment effort.

II. Results

The tests carried out within the scope of the THEK project have confirmed that in the conditions of the project¹, the following numbers can be used as a base for the use of the converter modules:

Operating temperature up to 320°C
Overall instantaneous heliothermal efficiency.....greater than .72
Energy efficiency over a typical day.....about .70

These are not laboratory performance numbers, but numbers used in setting up the industrial specifications.

*In the name of the THEK team which also includes: M. Audibert, J-P. Battistelli, J. Desautel, B. Imbert, G. Gasperini, and R. Pasquetti.

The THEK project, developed by the Department d'Heliophysique of the Universite de Provence (E.R.A.-CNRS. 538) was set up in 1975 by the CNRS within the scope of the "Solar Energy Research and Development Project (PIRDES)."

As applied to average conditions in the Marseilles region, and taking into account additional losses due to the requirements of real, on-line operation, these numbers may be used to predict an annual heat production of 50 to 55 thermal MWh for each 50 m² module.

In addition, experimentation carried out over a period of 2 years on two prototypes operating in real-life conditions has been used to evaluate a series of technical solutions for the construction of these modules and to analyze the physical problems raised by their operation in an essentially dynamic mode.

III. THEK 2

This second step in the project corresponds to an intermediate step between the study and the implementation of the module on the one hand, and the design of operational systems on the other. Its objective is to identify the problems raised by the joint operation of several modules on a common collector network. It should lead to the selection of a series of solutions concerning the choice of principles to be applied to establish a network, and the management of the network.

In order to conform to the "medium power" project as initially planned, that is corresponding to energy production in the range of 5 to 500 kW of electricity (or 25 to 2,500 kW thermal) in peak production, the study was carried out on networks including up to 100 modules.

However, for obvious reasons, the experimental implementation will be carried out with about 10 modules only, which corresponds to a nominal power of 250 to 300 thermal kW.

In this study, we have attempted to take into account the fact that systems must be able to respond to various utilizations of heat, along a fairly wide heat range (100 to 300°C). The result is a number of variations in the implementation of the network and the management of the energy produced. Thus, we have been led to examine two experimental installations as a first approach:

The first one, THEK 2H (fig 1) uses oil similar to that used in THEK 1 (GILOTHERM TH or MOBILTHERM 605) to carry out heat. It is intended to be coupled to a thermodynamic conversion loop operating around 275°C and actuating a 50 kWe alternator. The first THEK 2H installation is planned to be implemented in Corsica, around Ajaccio, where it will be connected to a thermodynamic loop being constructed on an experimental COMES/CNRS site. The loop, installed by SOFRETES and the CEA [Atomic Energy Commission], and including mixed storage (thermal oil and rock), uses a BERTIN organic fluid turbo-alternator. These alternators, designed for instantaneous power around 50 to 300 kWe, have a high mechanical efficiency (higher than .78) and, depending upon the power output, yield a thermodynamic efficiency higher than .25 from 270 to 350°C. An overall efficiency of 18 to 20 percent can therefore be expected in the THEK 2H helioelectric unit.

THEK 2 Schematic

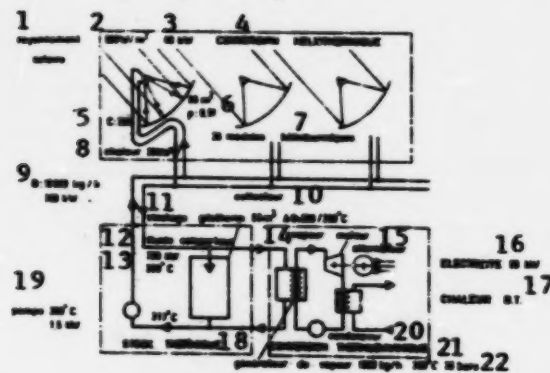


Figure 1.

Key:

- | | |
|---|--|
| 1. Sun rays | 12. Heat carrying fluid |
| 2. 800 W/m^2 | 13. 700 kW , 300°C |
| 3. 48 kW | 14. Steam |
| 4. Heliothermal conversion | 15. Motor alternator |
| 5. 230°C | 16. 93 kW electricity |
| 6. 50 m^2 ; efficiency = .87 | 17. Heat |
| 7. 26 heliothermal modules | 18. Thermal storage |
| 8. Heat: 29 kW | 19. Pump: 300°C , 1.5 kW |
| 9. $Q = 12,600 \text{ kg/h}$; 750 kW | 20. Condenser |
| 10. Collector | 21. Thermodynamic conversion |
| 11. Geotherm storage: 56 m^3 ,
$\Delta \theta = 300/280^\circ\text{C}$ | 22. Steam generator: 1000 kg/h ,
280°C , 26 bar |

Obviously, this type of installation is intended for electrical production units located in isolated regions with clear skies and also, as a second step, simultaneous production of heat and electricity at different temperature levels.

The second one, THEK 2V, involves direct production of industrial steam (fig 2). It utilizes a pressurized water loop leading to a steam generator. The design nominal power—around 300 thermal kWh —should enable it to deliver 350 to 400 kg/h of steam at $180^\circ\text{C}/10 \text{ bars}$. Following are some of the elements involved in the choice we had to make to design such an installation.

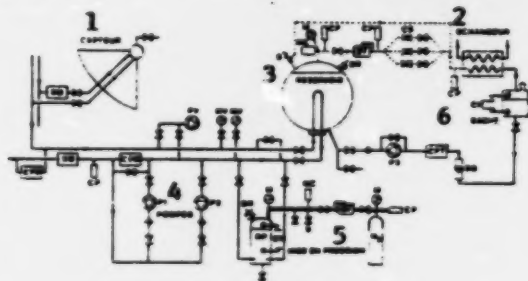


Figure 2. THEK 2V schematic.

[Key on following page]

Key:

1. Collector	CN: Level detector	DT: Pressure regulator
2. Exchanger	CP: Pressure	M: Pressure gauge
3. Tank	CPD: Differential pressure	MC: Pressure contactor
4. Pumps	CPT: Counter	MV: Vacuum pressure gauge
5. Pressurization	CS: Venturi	P: Pump
6. Cover	DB: Flowmeter	FV: Vacuum pump
	DR: Breakout disk	S: Pressure safety valve

IV. THEK 2V Installation

a. Storage Fluid:

In the case of THEK 2V, the storage fluid consists of pressurized water. As compared to pressurized water, oil has the advantage of operating close to atmospheric pressure up to temperatures around 330 to 340°C. On the other hand, they have some disadvantages such as:

--Much lower specific heat (larger volume required to store the same amount of energy),

--Risk of degradation of the fluid in case of overheating,

--High cost.

The main disadvantage of water is in the high pressures the circuit must withstand when temperatures are raised (thicker, heavier, and more costly tanks).

If water temperature is limited to 220°C under 23.5 bars, the net situation is in favor of water because of the lower cost of the fluid, the simplification of the regulation system, and also from the fact that we can save on a steam generator and the associated pumping station. In the present installation, steam at 180°C under 10 bars is produced simply by letting out steam from the top of the tank. In operation, water temperature varies between 180°C/10 bars (discharged storage) and 220°C/23.5 bars (pressurized storage).

b. Heat transfer fluid:

Among the possibilities studied the choice was made, at least for the initial experimentation, to use pressurized water circuits separated by a heat exchanger (fig 3). As compared to two-phase solutions (water and steam), this is the one that uses the least energy while keeping the network regulation and balancing problems reasonably simple⁴.

c. Network:

The network was designed in order for its characteristics (distance between collectors, pipe diameter, insulation thickness, etc.) to minimize losses from collector shadow, pumping power, thermal losses, thermal inertia, etc., and investment costs.

Instead of the theoretically optimal solution³, which requires an extensive balancing system, a system using associated loops with equal lengths of pipe from all collectors has been preferred. This provides for significant simplification in the selection of pipe diameters (standard size), valves, etc.

d. Pumping system:

The optimization of this system with respect to the yearly energy consumption includes a fixed-rate pump which handles maximum sun periods and peaks, and a variable rate pump related to solar flux and to the highest furnace output temperature.

e. Network pressurization:

It is maintained at 53 bars (corresponding to maximum temperature conditions), using a compressed nitrogen tank which also operates an expansion vessel (2.1 m³).

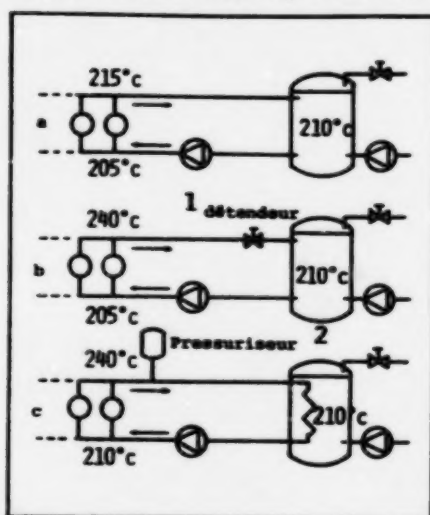


Figure 3. Possible configurations of the primary loop.

Key:

1. Pressure-reducing valve
2. Pressurizer

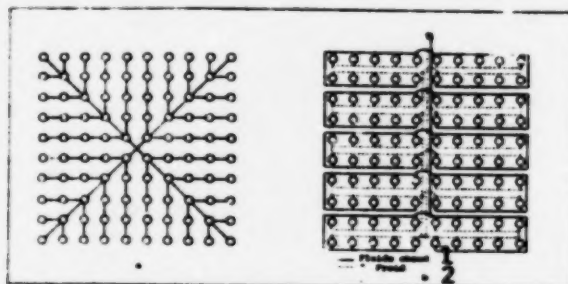


Figure 4. Network.

Key:

1. _____ hot fluid
2. cold fluid

f. Tank:

Resulting from a close adaptation between utilization and the thermal loop, its capacity in the case of THEK 2V is arbitrary. We have selected a typical case using a 50 m³ tank, which corresponds to a sphere 2.3 m in diameter and 45 mm thick, with heavy insulation. The primary heat exchanger is installed inside the tank.

g. Control:

Obviously, the operation of the installation is automatic as far as the following functions are concerned:

- Collectors orientation (sun tracking)
- Overall flow regulation
- Installation start-up and stop (depending upon sun conditions)
- Collectors monitoring (operating safety)
- Information on instantaneous operation of the field
- Recording of all measurements necessary to evaluate the performance of the installation (daily, monthly, and yearly accounting).

Some of these functions are controlled centrally using a mini-computer. Others are controlled directly at each device.

The detailed operation of the system, which has been described separately⁴ has been studied while taking into account the experimental nature of the installation. It should however be useful to evaluate some principles or materials which have been used, in view of their use in industrial installations.

h. System operation:

In nominal conditions, the 10 collectors are automatically oriented and pointed toward the sun, the pumping system circulates pressurized water between the collectors and the storage tank exchanger. Water comes out of the exchanger at a temperature 5°C higher than the water in the tank; it is distributed in parallel to the 10 collectors in a network whose pressure is maintained at 50 to 60 bars in order to prevent evaporation. After being heated in the collectors, the water returns to the exchanger where the heat is transferred to the tank water. The flow of water in the network is regulated by varying the pumping velocity as a function of the incident solar flux and storage temperature. The latter varies during the day between two limits: a 180°C limit corresponding to the unloaded tank, and an upper 220°C limit (23.5 bars) corresponding to a tank under load.

Steam production is obtained by releasing the tank steam at 10 bars. During this isenthalpic release, steam is cooled to a temperature close to 180°C. In this experiment it is then condensed to be reused in the circuit.

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CSO: 3102/427

ENERGY

BRIEFS

SYNTHESIS GAS PLANT IN FRG—The first synthesis gas unit to be built in FRG, based on a new technology, will be started by the company Rheinische Braunkohlenwerke. It involves a \$163 million project that includes four units with individual capabilities of 300 million cubic meters per year, the first of which could be operating as early as the middle of 1984, with the whole project being ready in 1987. Rheinbraun then expects to use 2.2 million tons of lignite per year, supplied by the mines of the Rhineland company. The synthesis gas plant will be connected by pipeline to the petrochemical complex Union Rheinische Braunkohlen-Kraftstoff for methanol production. The project uses an improved high temperature version of the Winkler gasification process. Fluidized bed gasification of the lignite is enhanced by the use of oxygen and steam at a higher pressure. Since the cost price of lignite is lower than that of coal, this is an interesting solution. [Text] [Paris SEMAINE DE L'ENERGIE in French 14 Sep 81 p 11] 11,023

NEW COAL GASIFICATION PROCESS—KHD Humboldt Wedag AG has developed a new auto-thermal coal gasification process using a liquid iron vat. The resulting gas contains almost only CO and hydrogen. It is practically sulphur-free (less than 20 ppm) and CO₂-free and in many cases, it can be used directly without additional scrubbing. The pilot installation planned to test the Humboldt process will be capable of gasifying 10 tons of coal/hour under a pressure of 10 bars at 1350-1400°C. It will produce 20,000 m³/h of gas. It is planned to go into operation in 1982. The process is based upon the dissolution of coal in liquid iron, followed by gasification per se. It presents many advantages: it can use all types of coal and does not generate by-products such as tar and hydrocarbons. The resulting gas is usable as synthesized gas and may be used without de-sulphuration in gas/steam turbines to produce electricity. [Text] [Paris INFORMATIONS CHIMIE in French special edition Jun 81 p 97] 6445

CSO: 3102/427

INDUSTRIAL TECHNOLOGY

NC MACHINE TOOL FUNCTIONS ON UNMANNED SHIFT

Paris L'USINE NOUVELLE in French 17 Sep 81 pp 114-115

[Article by Patrick Piernaz: "At SHC the Machine Works by Itself at Night"]

[Text] It is now possible to allow a numerical control machine-tool to operate unattended during the night and on Sunday. A subcontractor specializing in glassware molds relates his successful experience with an unmanned shop.

A carousel of pallets, a machining center, and a local compressor: that is all that is needed to have an autonomous machine-tool capable of operating without manual intervention during an entire night and on weekends.

Seen at the latest large international shows in Chicago, Tokyo, and Hanover, these are the new generation machine-tools. They are harbingers of the first unmanned shops; very few enterprises in the world can boast of having one. And even fewer dare to fully utilize all their capabilities, which means to close the plant in the evening while leaving the machine to operate entirely by itself with its supply of pallets carrying the parts to be machined.

In France, a subcontractor was the first one to try it: SHC, at Ternay (98 employees and 3.5 million francs of business), specializing in the manufacture of glassware molds (for bottles, jam jars, and condiment containers). "We machine cast iron parts in 10 to 50 unit runs. The machining time per part varies from 15 minutes to one hour and 40 minutes," says Jean Sogner, the director of the enterprise. The machining operations are conventional: drilling, tapping, filing, and milling; the complete machining of one part (consisting of two mold halves) requires two different set-ups.

Great Confidence in Equipment

When the numerical control program is ready, the parts merely have to be mounted on the carousel pallets, and the machine processes them one after the other. The ten pallets provide an average autonomy of eight hours. Under these conditions it was indeed tempting to load the machine in the evening and find the ten parts completely processed in the morning, with the advantages of shorter delivery times and better amortization of the machine. That is what SHC did. "The evening shift prepares the

parts and starts the machine; before closing the shop, it shuts down the large general purpose compressor and turns on the smaller compressor purchased specially for the machine," explains Jean Sogner. When the morning team arrives, the machine is generally completing its run; otherwise it will have shut itself down. At which time the finished parts are removed and replaced with unprocessed ones. "The operation is similar for the weekend: the parts are prepared on Friday; on Saturday or Sunday, one of us comes to change the parts on the carousel, a task which takes less than one hour," points out Antoine Cipriano, set-up man.

Allowing a machine to operate unattended requires a certain amount of confidence in the equipment. But what happens in case of trouble? The machine, operating on its own, turns itself off when the work is finished, and causes the compressor to shut down as well. "We have never had any serious breakdown, only tool breakage," points out Jean Sogner. "And the machine, which has been working for 18 months, has already logged 3702 hours of machining! Of course, we also know our cutting conditions very well since we always machine the same metal: annealed and stabilized cast iron. We start with machined surfaces, and in particular, we devote great attention to the quality of the cutting tools; you cannot stint on this issue. All the tools are changed and resharpened for each run. An average of 15 tools are needed per part, out of a total of thirty in the changer." Some of the machining is spectacular, such as boring a 6.5 mm-diameter, 350 mm-deep hole, or drilling tiny holes (0.7 mm in diameter) at 12,000 rpm.

It is this need to change all the tools for each run, and to be able to regularly check their condition, that motivated the selection of the Yasda machining center, equipped with a 30-tool changer (15 kW spindle power). "The tool changer is at eye level and thus easily accessible," we are told by Jean Sogner, who consulted various suppliers and travelled to Belgium, Germany, Sweden, and Holland to inspect equipment in operation (but could see no center with a multi-pallet carousel). Three other criteria determined the choice made by the SHC director: the large travel of the machine (allowing operations with very long tools); the simple design of the tool changer, an indication of reliability (no breakdown so far); and the accuracy of the work. The machine was installed and started by a technician from Univacier (Yasda's representative in France), in two 15-day visits.

Two people are currently operating the machine. The set-up man who loads the parts on the pallets, removes them, deburrs them, supervises operations, and sets up the next commands; and the programmer, Diego Gimenez. The latter prepares the program tapes and feeds them to the numerical control computer (Fanuc System 7) with which the machining center is equipped. This is a relatively long task: "For the time being our programming time reaches five to six hours per part, because we operate with manual programming. But we will soon adopt automatic programming, which will reduce this time to two hours." This improvement will be extended to all the CNC (numerical control) machines in the shop: 14 CNC lathes (the oldest dating back to 1970), used in two shifts, require the work of five programmers.

Another project presently under study, will allow Jean Sogner to double the autonomy of his machining center; this involves the mounting of four mold-halves on each pallet, instead of the current two, thanks to a modification of the attachments and part holders. These two approaches will further improve the already positive balance of the installation of a machining center. The new machine, which required an investment of about 1.3 million francs, has replaced the work performed on two universal milling machines, and has reduced machining time from one week to one day by eliminating eight intermediate handlings.

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TRANSPORTATION

FRENCH STUDY OUTLINES EUROPEAN HIGH-SPEED TRAIN NETWORK

Duesseldorf VDI NACHRICHTEN in German 28 Aug 81 p 9

[Text] After the French Railroads (SNCF) proved on 26 February of this year with one of its new electric trains (TGV) that speeds up to 380 km/hour can be controlled safely on rails, scheduled high-speed operation is to begin at the end of September this year on 301 kms of the new Paris to Lyon line, which is intended exclusively for high-speed traffic. For the beginning, 40 units ("Ramas") are available; an initial total of 87 TGV trains is being acquired.

Each TGV train consists of two 4-axle driving units, developing 6,300 kW together, and 8 intermediate coaches. The distance between the trucks on the driving units is 14 meters, distances between the axles is 3 meters, the total number of seats is 386, 111 of them in 1st class. Two driving units can run as a double unit, providing 12,600 kW of power and 722 seats. The length of the eight-coach train, with one driving unit at each end, is 200.19 meters. Two coaches are supported on the twin-axle running bogies, except for the first coach truck behind the driving unit. So the entire TGV has only nine running trucks and four driving trucks. The brake system consists of resistance brakes, disc brakes and block brakes. The speed to be maintained is shown in the cab and constantly checked automatically.

Through-operation for 260 km/hour on the entire 389 km-long high-speed Paris-to-Lyon line will commence in 1983; travel time will be 2 hours.

The noise level of the all-electric operation is said to be lower at 260 km/hour than that of traditional trains at 160 km/hour. Over distances up to 600 km, city center to city center, the high-speed train is not only quicker than the airplane, according to railroad statements, but the energy consumption is also considerably lower (one-fourth to one-fifth of the Airbus).

Now an examination is being made of which railroad lines in France can be converted to TGV links. Efforts are further under way to recommend the national TGV model for a super-TEE [Trans European Express] system to link the major cities of Europe. In a French study on the subject the statement is made that 27,000 kms of railroad line in Europe can be modified in a short time for the operation of standardized, light and powerful TGV's with maximum speeds of up to 240 km/hour. The 5,000 to 6,000 km of new track planned for this decade would allow speeds of 260 to 300 km/hour. Paris to Brussels would be covered in 1 and 1/2 hours, Paris

to Rotterdam in 2 and 1/2 hours and Paris to Cologne in 4 hours. So that the TGV can run on all the electrified lines in Europe using different currents, the electrical system of the driving units is designed for 25 kV/50 Hz and 15 kV/16 and 2/3 Hz AC and 1.5 kV DC current.

TGV traffic for all of Europe would require about 1,000 trains. The study recommends a division of labor to build these trains, after the example of the "50 Hz consortium," in which several companies of the West European railroad industry are already working together. This industry structure is "in the immediate position of being able to introduce the TGV system successfully in Europe and the entire world."

9581

CSO: 3102/425

TRANSPORTATION

SHORT REPORT FROM AIRCRAFT INDUSTRY: A 310, CFM ENGINES

Bern TECHNISCHE RUNDSCHAU in German 1 Sep 81 p 33

[Excerpts] Distributed across all of Europe, A310 components are taking on their final shapes and being flown by special plane, "Super Guppy," to Toulouse for final assembly. The 5.2-ton wing was developed at British Aerospace and is being built today in the BAe factory at Chester (North Wales). The wing has an area of 40.6 m² and a length of 21.5 m. The forward section of the fuselage of this 210-seat passenger aircraft is being built at Consolidated Aircraft Works VFW in Bremen and is subsequently mounted on the cockpit section in Toulouse. The cockpit of the A310 is equipped with six screens (two each for the artificial horizon and the level indicator and one each for a warning and systems indicator). The fuselage center section is built at Aerospatiale in St Nazaire (France). The first A310 short- to medium-range aircraft will be delivered in 1983, after an intensive flight testing program, to Swissair, which has ordered 10 units.

For maintenance of the A310, Airbus Industrie has formed a team with its customers, which will establish a maintenance program for the entire aircraft. The program will then be approved by the European certifying authorities. The committee, led by W. Schippert (Swissair), includes besides manufacturers' representatives from Airbus Industrie, Aerospatiale, BAe, MBB and VFW, the engine manufacturers GE and P & W and the airlines Air Afrique, Air France, British Calendonian, Lufthansa, KLM, Kuwait Airways, Sabena, SAS and Swissair. Six work groups were formed for detail operations. The most important areas include the airframe, engines and APU [auxiliary power unit], hydromechanical systems, general systems, avionics and aircraft inspection.

New CFM56 Engines

CFM International, a joint-venture company of General Electric USA and SCNECMA in France, has developed two new versions of its CFM56 engine. CFM developed a more powerful version (the third) of its CFM56-2 for short-range aircraft in the 120 to 140-seat category. This version has already been selected by Boeing for the B737-300 and will start flying in 1984. In the CFM56-3 the core and the low-pressure section of the CFM56-2 are combined with a new, smaller fan. The engine develops a thrust of 90 kN, which is an increase of 30 percent over the present thrust of a B737-200. To meet the requirements of the airlines, a further version is planned, the CFM56-2000. This engine is to cover the power range between 100 and 150 kN and is intended for the new market of the 150-seat aircraft. Airbus

(A320-100 and -200), McDonnell-Douglas/Fokker (MDF-100) and Boeing (B787) are competing in this market. The new engine will contain the newest findings regarding materials and manufacturing methods. The new engine technology basically includes the following:

- Single-crystal turbine blades
- New ceramic material as a core for casting hollow blades
- Blade manufacture in two halves
- Large-bladed fan blades
- Powdered-metal discs
- Active alteration of radial play
- New combustion chambers
- Electronic engine control

Plans are to gradually realize the new CFM56-2000 technology in the CFM56-2 and -3 models as well, which will make them even more economical.

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CSO: 3102/425

TRANSPORTATION

DORNIER'S DO-228: ECONOMIC WAGER ON ADVANCED TECHNOLOGY

Paris AVIATION MAGAZINE INTERNATIONAL in French 1 Sep 81 pp 24-25

[Text] The Dornier commuter 228-100 and its longer model 228-200 were introduced for the first time at Bourget, in June, only a few weeks after their test flights. Their builders consider them to be as competitive as their most dangerous rivals. The aircrafts' main attraction is the performance of their wings that were developed by a research program financed by the West German government. Although the construction techniques used are not common to this type of aircraft, they have produced appreciable advantages in performance as well as in cost and maintenance. If the commercial success of the DO-228 cannot yet be assumed, the statement can be made that this is the first time that so much acquired technology has been brought together on an aircraft of this type. Only the future will say whether this course of action will prove profitable.

In the beginning of Dornier's offensive in the commuter aircraft market, there was, of course, a study made of the market (see Aviation Magazine International No. 800, p 42). Also, there was a research program financed by the Federal Ministry of Research and Technology to study wing design. This program was known as the TNT Program [Tragflugel Neuer Technologie-advanced technology wing]. The broad objectives of this program package were the improvement of the aerodynamic effectiveness of light aircraft wings so as to upgrade operational performance.

In more precise terms, the program dealt with the development of a new contour design that would provide an appreciable improvement in lift capability and in the lift/drag ratio. The program also perfected the wing's extremities to reduce drag and slotted flaps, fitted to the wing's contour, to provide a higher lift capability and a relatively light drag during ascent. Finally, it developed construction techniques that would make production possible at a reasonable cost.

The TNT program began in mid-1975 and continued until last year. The results were as expected which led to the setting up of the DO-228 program.

The advanced technology wing has a contour characterized by a relatively significant thickness (16 percent throughout the center section) with an under surface of sandwich construction. The wing's central section is rectangular in shape, up to the engine pods, and extends beyond to tapered outer panels and triangular wingtips. (The relative thickness at the wingtip is 4 percent). The dihedral is zero up to the engine pods and becomes $+4^{\circ}$ on the outer panels.

Wing span	16.97 m (55 ft 8 in)
Wing surface	32m^2 (344.5 sq ft)
Wing aspect ratio	-9

The central section has no sweep; however, the outer panels have a sweep of $+8^{\circ}$. There is also a slight twist at the wing root (in relation to the fuselage) calculated to be $+2.2^{\circ}$ and -3° on the outer panels.

The wing is constructed in three main sections: the central section including the engine pods and the two outer sections. Each section is a box, the upper and lower surfaces of which are panels of heavy sheet metal manufactured by numerically controlled machines. The longitudinal and transversal stiffeners are machine produced, thereby doing away with the conventional riveting of spars and ribs and resulting in a smooth surface. The panels are formed by machine press. According to Dornier, such integrally milled construction has many advantages: there is less drag (since there are no rivets); less weight, less cost, and longer operating life. Actually, this is the first time that this technique, normal for military aircraft, has been used on a craft of this type.

Other advanced techniques that Dornier mastered particularly during the "Alpha Jet" program have been used in the construction of the DO-228, e.g., shaping of parts in a chemical bath, anode protection, electronic welding, supersonic cleaning, etc. In addition, some parts have been made from carbon fibers and Kelvar fibers composites.

This combination of modern techniques and proven conventional techniques (developed mainly for construction of the fuselage) has made it possible to build a unit whose operating life expectancy is more than 24,000 hours, which is equal to 15 years of use at 1,600 hours per annum.

The first aircraft in series production will come off the line in a few days. Assembling began in May at the same time the prototype was making its first test flights. Plans have been made to build machinery to produce more than 300 aircraft.

The short delay between the prototype test flights and the appearance of the first aircraft of series production was in large part due to the experience gained during the TNT program. It was under this program that an experimental model (a modified "Skyservant" fitted with Alpha Jet landing gear) has made more than 200 flights since 14 June 1979. This experimental TNT aircraft, powered by two Garrett TPE 331-5 (715 hp) turboprop engines, has performed as follows:

Horizontal speed	- 63 to 337 km/h (34 to 182 knts)
Banking coefficient	- $+3.3$ to 0.5 g
Rate of climb	- 20% with 2 engines 5% with one engine out

During the summer of 1980 the experimental aircraft was fitted with various types of propellers developed by Hartzell and Dowty (supercritical, all Kelvar blade, etc.), which ultimately resulted in the adoption of all metal Hartzell propellers for the DO-228.

The experimental TNT wing also supports research in cooperation with DFVLR /German Research and Test Center for Air and Space Flight/ on gust absorption (OLGA, Open Loop Gust Alleviation) which should increase passenger comfort. This system will also be adopted for 228 production.

Finally, in light of the experience acquired, the following stage concerns the development of new propellers for use with engines of from 750 to 1,000 hp. Dornier, DFVLR, and Hoffmann are conducting this program with government financing.

By launching the DO-228-100 and the DO-228-200, Dornier has made two wagers:

Commercial Wager

At a time when all builders are devoting their time to aircraft capable of carrying more than 30 passengers, the German builder has set his sights on the lower class, capable of carrying 15 to 19 passengers, and on replacing such aircraft as the Canadian "Twin Otter" which made a fortune for its builders.

Technical Wager

For the first time, the German builder has used advanced technologies on aircraft of the 5.7 ton class so as to be able to offer economic advantages and improvements in decisive performance.

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TRANSPORTATION

GOVERNMENT TO TIGHTEN EMISSION STANDARDS FOR NEW CARS

Stockholm NY TEKNIK in Swedish 27 Aug 81 p 3

[Article by Norbert Anderson]

[Text] The National Environmental Protection Board is now tightening auto emission standards. Beginning with 1983 models, manufacturers can no longer cheat when it comes to exhaust emission control, at least not to the same extent as before.

According to the new regulations of the National Environmental Protection Board, at least 60 percent of the automobiles sold must meet exhaust requirements. Otherwise, the board's approval can be withdrawn.

At present, only a small fraction of the automobiles on the Swedish market meet emission standards.

Well known automobile manufacturers such as Volvo, Saab, Opel, Peugeot, Vaz, and others have not constructed their engines so that they meet the requirements.

They have been able more or less to disregard the emission standards because of the present regulations for approval.

The Environmental Protection Board presently grants its approval based on tests of prototypes. The tolerance is increased for series production. Many of the automobiles that leave the assembly line do not meet the requirements.

The Environmental Protection Board can do nothing because it has already approved the prototype.

In addition, parts in the carburetors and engines gradually become worn. For most automobile models, this means that after several years only a few cars meet the requirements-- even after the manufacturer or importer has made adjustments in the carburetor and the ignition system.

Beginning with the 1983 models, however, the Environmental Protection Board will make continuous random checks of automobiles that have been driven between 3,000 and 15,000 km.

If more than 40 percent exceed the maximum values the automobile manufacturers will have a certain time to correct the problem. If there is no improvement, the type approval will simply be withdrawn.

Sweden's automobile industry and the automobile dealers' association have appealed to the government to overturn the Environmental Protection Board's decision.

The new automobile emission statement also places more responsibility on the automobile owner. The emissions check presently made at the annual auto inspection is rather lax.

Now, however, the inspection methods will be refined. In this way, greater requirements will be made on automobile owners to keep their car in such condition that it does not emit unlawful amounts of exhaust gases.

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TRANSPORTATION

VOLVO PLANS CERAMICS-COATED ENGINES IN FIVE TO TEN YEARS

Stockholm NY TEKNIK in Swedish 20 Aug 81 pp 6-7

[Article by Jan Segerfeldt]

[Text] Volvo now plans to use ceramics in future automobile engines. A thin ceramic layer on parts of the engine makes it possible to increase the temperature, thereby increasing efficiency. The engine of the future will be lighter, cleaner, and more energy-efficient. Volvo has employed Norwegian ceramics experts in the experiments. If all goes well the ceramics can be in production in 5 to 10 years.

Intensive research has been underway for 10 years at the Institute of Industrial Research (SI) in Norway to study the surface coating.

By coating the valves and cylinder head with a thin ceramic layer, an effective heat barrier is created. The heat barrier reduces the thermal dissipation from the hot combustion gases to the surrounding metals.

The efficiency can then be increased by having combustion at a higher temperature.

Another alternative is to allow combustion to occur at the same temperature as in a normal engine, but the efficiency would then be the same as in a conventional engine.

The consequences of the latter alternative are that metal with a lower melting point than steel could be used for parts in the engine that are subjected to heat.

Burnt Pistons

Bergesens Skibsrederier A/S originally stimulated the interest of the SI researchers in heat insulation and engines.

The shipping company had problems with burnt pistons in the large diesel engines of its ships.

"The shipping company commissioned us to find a solution to the problem of the expensive burn damage," Dr. Ingard Kvernes said.

The investigators sweated over the burnt valves and pistons and their knowledge grew.

Volvo observed the researchers in Norway and wondered whether ceramic technology could also be used in automobile engines.

The Norwegian-Swedish project for a more efficient automobile engine was underway.

Built-In "Push"

The ceramic powder, which is melted and sprayed onto the engine parts, consists of zirconium, magnesium, and calcium oxides. This composition provides a crack-resistant increase in volume when the melt solidifies. Many small "microcracks" in the surface are formed which, in turn, limit the ability of larger cracks to form.

Cracks are readily formed when a material is coated with another material.

The different coefficients of thermal expansion in the coating material and the base material create tension during heating and cracks may be readily formed.

"A surface consisting of both ceramics and metal, applied before the surface layer, may solve the crack problem" Dr. Kvernes said.

Ceramic layers thicker than 1 mm are difficult to make and the researchers believe that thicker layers are hardly applicable to industrial production.

Higher Efficiency

In addition to the ceramics of the surface layer, it is possible to mix in substances that can serve as catalysts during combustion.

"Combustion would then occur more rapidly and easier with the 'push' the reactions receive from the catalysts," Kvernes said.

Up to a 300 degree increase in gas temperature in the combustion chamber or a 60 degree lower temperature in the surrounding metal--these are the two extreme cases provided by the ceramic layer. A commercial engine would probably be somewhere in between these figures.

The higher the combustion temperature, the higher the efficiency. Thus, a higher gas temperature means that a greater efficiency can be derived from a smaller quantity of fuel.

The possibility of decreasing the temperature of the metal surrounding the combustion chamber provides other advantages. The risk of thermal fatigue is reduced and a colder metal is more rigid than a warm metal. Most important, however, lighter metals with lower melting points can be used and pistons can be made of aluminum.

The price of gasoline and diesel oil, exhaust regulations, metal prices, and questions of lifetime and maintenance will be decisive in determining how the advantages of the ceramic layer will be utilized.

Applying the technology to industrial production should be quite simple according to the researchers. Reliable equipment for plasma spraying is on the market. In the aviation industry it is common for jet engine parts to be plasma sprayed with alloys that decrease air resistance.

Ceramics At Volvo

Ceramic spraying in series production must be done by robots, according to Dr. Kvernes.

"A high degree of reproducibility is required to form an equally thin layer that covers the entire surface of all the product," Kvernes said.

It is important for the spray gun to receive the correct quantity of electric energy. If the energy is too low relative to the grain size, the grains of the powder can remain unmelted. A grain that does not melt together with the remaining ceramic layer makes the surface susceptible to crack formation.

The results will be evaluated after Christmas. It will then be decided whether the experiment will lead to field tests in test cars.

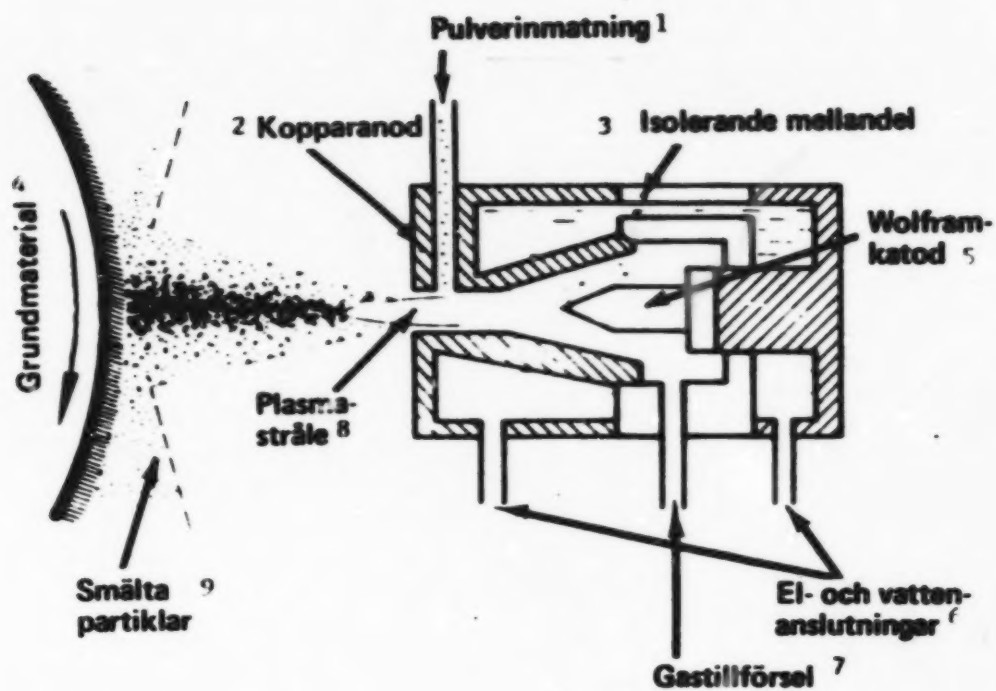
"If Volvo likes the test results, the technology may be used in automobile engines in 5 to 10 years.

Plasma in Gun Melts Powder

In the spray gun an arc is formed between two electrodes, one of copper and one of tungsten. The arc's energy ionizes a gaseous mixture, for example hydrogen and nitrogen. The energy-rich plasma thus formed consists of ions and electrons.

The ceramic powder is added before the plasma flows out of the gun. The powder consists of zirconium, magnesium, and calcium oxides. The powder is melted by the energy liberated when the ions and electrons return to their stable, lower energy level as gas molecules.

The molten powder particles are thrown against the base material and are flattened as they strike this material.



1. Powder inlet
2. Copper Anode
3. Insulating middle section
4. Base material
5. Tungsten cathode
6. Electricity and water connections
7. Gas supply
8. Plasma jet
9. Molten particles

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TRANSPORTATION

SOPHISTICATED ROBOTS USED TO PRODUCE RENAULT R 9

Paris LE NOUVEL ECONOMISTE in French 21 September 81 p 66

[Article by Alain Jemain: "The 120 Robots Which Manufacture the R 9]

[Text] The idea was to beat the most widely sold car in the world, on the twin fronts of economy and quality. In less than three years Regie Renault put itself in a position to do it.

"Make it better than the Toyota Corolla." In 1978, when Bernard Hanon, the automobile boss at Renault, gave the green light to his engineers to install the industrial facilities for the R 9, this was an awesome goal: to beat the most widely sold car in the world on the grounds of economy and quality. In less than three years, Renault had achieved the largest technologic leap since its creation. This change involved robotics.

Freedom

Some 120 robots are working today at Douai, in the plant which makes the new R 9 at a rate of 560 per day--and at 1500 per day as soon as possible. These are true robots, which manufacture the undercarriage of the car (the floor), the engine cradle, and the front end, which perform the final assembly of the gear box, coat it with an undercoating compound, and spray the primer and the first coats of lacquer. Robots with six degrees of freedom for sheet-metal work, capable of moving in all directions like the hand at the end of the arm. With electrostatic bowls for painting robots, which are capable of spreading paints with 20 percent less waste, or of changing paint colors instantaneously depending on the instructions they receive. All of them, except for some dozen old Unimates, produced by Acma and Societe Mecanique of Castres, two Renault subsidiaries.

"Of the 4000 welds on the Renault R 9," we are told by Dominique Cousin, head of the sheet-metal department and responsible for the robotics project, "1500 are robotized, 2000 are made by conventional automated machines, and 500 are performed manually. We could go much further were it not for constraints of economy or absorption capacity. And during the coming months, we hope to prove that we can reduce the number of welds, without of course affecting the car's characteristics."

With horn rimmed glasses and tousled hair, Mr Cousin is 28 years old. A multi-faceted technician and already a veteran of automatic devices, he has, for three years and with a 120-person team, worked in conjunction with the Office of Central Methods and the Office of Advanced Technology in Automation, to install robots, define their tasks, and fine tune their operation. After having worked on the design of these large "bikes," he is now responsible for their utilization.

"Not too long ago," said Mr Cousin, "sheet-metal assembly operations required 12 to 15 hours per car. Today, the Japanese take between three and four hours. We are in the same ballpark. In terms of costs, we are 15 to 20 percent ahead of the Renault 14, which was already the most automated one when it came out in 1976."

Scrapping

Robots bring industry into another world. "A multi-point automatic machine, whose design was specific, lasted the duration of one model," observes Jose Dedeurwaeder, former director at Douai, who will now supervise the modernization project at the American Motors plant in Kenosha, which will produce 800 R 9's per day in mid-1983. "It then had to be scrapped. A robot, on the other hand, because of its versatility, will be amortized over three models, which means some 20 years instead of seven." And while the initial investment is slightly higher--15 to 20 percent at present--robots provide a quality and flexibility that was unknown with the previous automatic machines. Thanks to these obedient and disciplined machines, an operation can be modified in a maximum of two months and a minimum of several minutes, the time it takes to punch the keys of the programmable computer which controls it. Welds are accurate to two-tenths of a millimeter--and self-controlled--and the pace is regular and programmed from 5:20 in the morning to 11:00 at night (2 X 8). No more misses, no unexpected welds. And as all automobile builders know, quality will be the determining factor in the automobile competition of the 1980's.

To install this new equipment--estimated as a whole at some 400 million francs of the 1200 million invested at Douai for the R 9 groundwork--Renault had to undertake the greatest training and upgrading effort in its history: 80,000 hours for two years, added to which are 10,000 hours of residence with suppliers and 2000 hours of apprenticeship on the machines. About 1500 employees--of the 7300 in the plant--attended an information campaign. And while the introduction of robotics did not eliminate any jobs--the 35 robot welder operators are at the minimum of the BTS level--it did raise qualifications and salaries (from 5500 francs to 7000 francs for these same operators over a period of thirteen and one-half months).

Two major problems remain. The rapid promotion of a new type of staff which is as different from the assembly line "screamers" as are the specialties required for the conventional maintenance services. It will be especially necessary to obtain long term acceptance for uninterrupted work (3 X 8).

This is a growing requirement when the utilization of hundreds of million francs of investment depends daily on a handful of men.

TRANSPORTATION

RENAULT EMPLOYS ADVANCED AUTOMATION TECHNIQUES

Paris INGENIEURS DE L'AUTOMOBILE in French Jun-Jul 81 pp 43-47

[Excerpt] 1. Organization of Research and Development

The automation research and development of the Renault group is aimed at two objectives of different natures and magnitudes: as user of automation, controlling the favorable evolution of its own productivity, an increasingly fundamental factor in the competition among the world's automobile manufacturers; and as seller of production equipment, involved in the mechanical engineering field.

Upstairs, the Bureau of Scientific and Technical Affairs of the group has established automation as one of the important lines of activity. As a result, the automation program of the research plan is keyed to such topics as CAO (computer-aided design), production automation, flexible shops, robotics, and advanced components in automation. Connections are formed with university research laboratories, and with such public research activities in France and abroad as the GARA project of CNRS (National Council for Scientific Research). These research efforts directly support the design and development actions in various units of the group.

In the automobile branch, the Directorate for Advanced Technology in Automation studies and designs future automatic equipment needed by manufacturing: robots, CAO, numerical control, and assembly machines. The Directorate for Information Processing Systems installs information processing systems for production control, industrial data processing systems, as well as the CFAO (computer-aided design and manufacturing) network of the group, in association with the research centers of the group.

The development and industrialization of the automation products are provided by the industrial branch of the group, which has gathered within RIET all its automation activity: special processing machinery, assembly lines, fixed and flexible handling, programmable controllers and systems, measuring machines, automated shops, automation engineering studies, and training materiel.

2. Robotics

Let us examine in greater detail the activity of robots, one of the essential components of automation in batch processes.

We have seen that one of the obstacles to total automation of batch processes was the absence of universal machines capable of performing the very varied tasks of batch fabrication. Robots now fulfill this requirement in two ways:

- a) They are universal machines which, when adapted with specific tools, are capable of performing various operations which until now have been carried out by as many special machines;
- b) They are universal motion organs, which make it possible to automatically perform many handling tasks that were performed manually until now.

2.1 Robot Machines

In the first case, the essential application in the automotive industry is spot welding. Robots become a flexible alternative to the multi-point welding machine. The necessarily slower rate of robots is compensated by the flexibility and adaptability of these truly programmable tools. It is reasonable to think that within a few years all automotive body welding lines will be robotized. Nevertheless, problems with these robots still remain to be solved. Sufficient precision is necessary to allow not only welding on previously attached parts, but the matter of assembly must also begin to be solved. In addition, it is necessary to obtain a high productivity, meaning a significant number of welds per robot per time unit, to provide systems for practical and rapid programming and learning, and to keep track of the relative motion of the body with respect to the robots. And finally, it is necessary to be able to optimize and coordinate an entire line of several dozen robots. The welding process (welding points and weld control) must be reviewed in the light of the equipment's autonomy and absence of human supervision.

At present, welding robots are hydraulic for the essential reason that welding equipment is heavy (60 kg) and that the speed of hydraulics makes it possible to obtain good productivity.

The second large application of robot machines is painting, or more generally, spraying. The current problems, as compared to welding, are that the painting gesture is a dynamic one, which means that the robots have to be controlled not only statically as in spot welding, but dynamically as well. Moreover, the path of a painting robot requires the memorization of more information (tens of kilobytes for a gesture of tens of minutes), and that the present technology, until the introduction of bubble memories, allows the storage of only several minutes of live memory. Procedures for information compression by a factor of the order of 100 must thus be used, requiring techniques as sophisticated as those encountered in telecommunications.

With the painting robot, shape recognition systems must be brought into play. They are not necessarily very sophisticated, since a simple vertical line of photodiodes makes it possible to recognize the type of body which is moving in a horizontal direction, triggering a painting program stored in memory.

2.2 Displacement Robots

Robots are universal displacement machines, and this is the function which creates the large future market of robotics as major component of automation in batch processing industries.

Handling is the first type of application, where it is generally a matter of feeding a machine with parts from a stock. If the parts are perfectly arranged in a predetermined pattern, the present robots used for welding and painting can also perform this task by memorizing the path to be followed.

But in most cases some uncertainty exists about the initial position of the parts, and recognition systems must be used. These range from simple mechanical sensors, to three-dimensional recognition by TV cameras, and include ultrasonic sensors, strain gauges, lasers, and so on. All these devices are currently being studied at Renault with the aim of reaching efficient, economical, and industrial solutions. Many fundamental physics problems have to be solved. The use of TV cameras in industrial environments raises many problems due to variations in lighting. To avoid them, special cameras are now being studied to allow the programmed division of the image into several zones which are scanned successively with adaptation for sensitivity in each case.

The time for computation and numerical treatment of the video signal is equally a problem. In most operations, the total cycle time must be of the order of a few seconds; this can be obtained only at the expense of very rapid digital electronics, such as parallel processors. The system developed by Renault uses combinations of slice microprocessors.

Another function which is at the basis of any handling operation is the geometric command which makes it possible to perform a movement in a coordinate system different from the robot's system of coordinates. This involves the robot-space which is defined by the angles of rotation of the different axes, the tool-space, and the part-space.

The operation of geometric commands requires the capability of performing in real time, calculations of rotations in three dimensions, which are also carried out by rapid operators specially coordinated with each other for this task.

The use of geometric commands enables operations somewhat similar to those found in numerical control, linear and circular interpolation, work on moving objects (such as on a line), definition of a path in the object-space (such as grasping a part independently of its position), local modification of path as a function of changes in the object's shape (such as in deburring).

2.3 Robot Control-Protocol

All the functions which constitute the robot's intelligence are exploited in the robot control-protocol system.

Indeed, as the functions of the robot increase, a modular and adaptive information processing system for control is needed to support the necessary equipment and programs. Today, the first minicomputer protocols are being replaced with multiprocessor assemblies composed of electronic cards, each of which perform a given operation. It is thus possible to separately perfect each of the functions, and especially to achieve better execution times and large memory resources (32 Kbytes for painting). This is the case of the version V protocol, designed to control all the models of Renault robots. It includes the following cards, some of which are optional:

- Central unit card;
- Environment card;
- Three-axis incremental coder for hydraulic robot;
- Three-axis incremental coder for electric robot;
- Four-axis potentiometer card for hydraulic robot;
- Four-axis potentiometer card for electric robot;
- Geometric operator card;
- Shape recognition option;
- Disk, cassette option;
- Servo-arm card.

The 16-bit Intel 8086 and the AMD 2903 slice microprocessors are used.

All of this remains to be programmed: the language used is a task-oriented one, such as the Grafcet used in programmable automation.

This language can be integrated into a CAO station; thus, because of the connection with the tree-dimension computation system (RA3 type), and because of its graphic outputs, the system becomes a powerful tool for design and robot installation.

This makes it possible to place robots in the context of total automation and to use these programmable tools and material interface capabilities for designing entire automated, robotized lines, and effectively reach full integration within the four-level concept which we discussed.

- Automation Products
 - Robots
 - Handlers
 - Automotive carts
 - Special machines
 - Assembly lines
 - Flexible shops
 - Programmable automation
 - Command systems
 - CAO stations
 - Programs
 - Automation engineering
 - Training

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TRANSPORTATION

BMW SERIES 5: RESULT OF CAREFUL RESEARCH, HIGH TECHNOLOGY

Paris L'ARGUS DE L'AUTOMOBILE in French 10 Sep 81 pp 1, 5

[Article: "BMW Series 5: Triumph of Technology"]

[Text] The priority goal of BMW engineers is to maintain BMW's identity as an elegant sports car, while lowering fuel consumption. That explains why the new Series 5 bears a considerable resemblance to its predecessors, but it is nevertheless totally new: "no revolution, long live continuity in change," seems to be the doctrine of the Munich research offices, which we were recently able to visit during a very successful technical-tour day.

While it is hopeless to recount in detail all that we have glimpsed--several issues would still not be enough--we can usefully indicate some of the research orientations of this major force in automobile technology: we will discuss them after having noted that the Series 5 is a great achievement.

More Aerodynamic

Until 1979, BMW did not have a full scale wind-tunnel capable of accepting full size vehicles. After studying various European models, BMW adopted a French technology, that of the St-Cyr wind-tunnel, which we saw in the same size at Munich. The BMW, whose aerodynamics were not (at all) impressive, will now rate more than honorably, given that the BMW 528i now has a Cx of 0.385, or 12 percent less than its predecessor (manufacturer's figures).

The front is lower, with a spoiler, and the rear is 4 cm higher: this is an all-around improvement in terms of mechanical accessibility (new hood), trunk space (460 l, or 5 percent more room), and esthetics. Once again, the BMW has been intelligently modernized without sacrificing style.

Lighter

To slip through the air for lower consumption is valuable, but it is equally useful to reduce weight for the same purpose. Thanks to a better design (computer assisted), 13 percent thinner sheet metal was used for equal strength. This has resulted in a gain of 40 kg (9 percent) in the actual body, with a consequent total weight reduction of 60-90 kg depending on models: the obvious corollary is that with less dead weight to pull, the engine consumes less. The passengers have also profited from these new shell calculations: the rear seat gains 4 cm of leg room, and the driver 2 cm forward and 2.5 cm backward for seat adjustment.

Staid Four or Six Cylinders

True to form, the basic BMW model is equipped with a 1767 cubic centimeter, four-cylinder, carburetor engine, but one with a high compression ratio (9.5) and with combustion chambers identical to those of the six-cylinder. With 90 DIN hp, the 518 reaches a top speed of 164 km/h, and goes from 0 to 100 km/h in 14 sec. Fuel consumption remains extremely low: 7 l, 9.5 l, and 11.1 l, at 90 km/h, 120 km/h, and in city driving, respectively; it becomes 6.4 l, 8.7 l, and 11.1 l with the optional five-speed gear box.

As its nomenclature indicates, the 520i is a 2 l (1997 cubic centimeter) injection model: it can be considered as the basic six-cylinder version, with its 125 hp. At a weight/power ratio of 9.8 kg per horse, performance becomes brilliant: 185 km/h top speed, and 0 to 100 km/h in 11.8 sec, for consumptions that are still attractive at 7.3 l, 6.5 l, 8.7 l at 90 km/h; 9.6 l, 8.7 l, 10.1 l at 120 km/h; and 12.5 l, 12.5 l, 11.9 l in city driving, depending on the respective model, i.e. manual BV4, manual BV5, or three-speed B Auto.

BMW 525i and 528i: Spirited

While the 520i is still equipped with the K Jetronic mechanical injection system and rear drum brakes, the 525i leads the top of the line with all the attractive features: L Jetronic electronic injection, four-wheel disk brakes, hydraulic (pump) power steering and brakes, and finishing refinements which include many electronic driving aids.

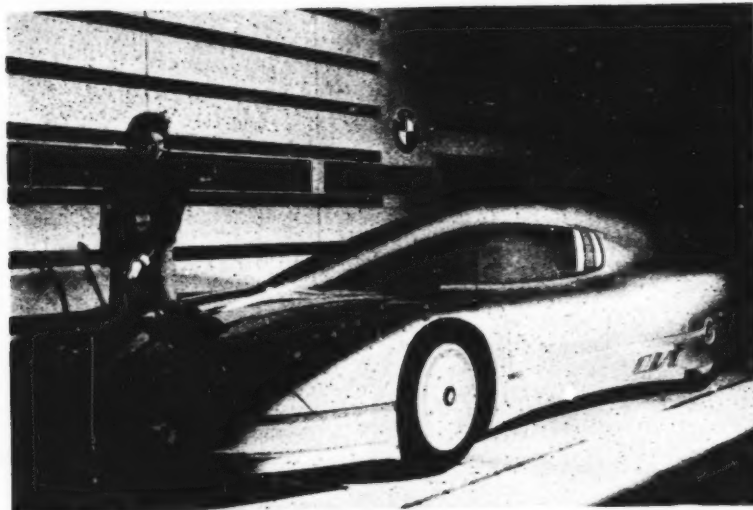
Strangely, the 525i and 528i have large hubcaps with an undeniable aerodynamic effect; in addition to being more powerful, these models are thus the only ones with a Cx of 0.385, while the Cx of the 518 and the 520i is undoubtedly not as good (although the figure has not been released).

The 2495 cubic centimeters of the 525i develop 150 hp at 5500 rpm: this power could be much higher thanks to the new heads and to injection, but it was kept down for insurance purposes, since in FRG 110 kW (150 hp) falls at the borderline between two rates! In return, the torque of 21.9 mkg is high: 100 km/hr can be reached in 9.9 sec, and the top speed is 197 km/hr. Fuel consumption still follows the same BV4, BV5, and BA3 order: 8 l, 7.2 l, 8.7 l, at 90 km/h; 10 l, 9.1 l, 10.7 l, at 120 km/h; 14.1 l, 14.1 l, 13.9 l in town.

Naturally, the best performances belong to the 528i: 2788 cubic centimeters, 184 DIN hp, 209 km/h, and 0 to 100 km/h in 8.9 sec. However, thanks to its five-speed gear box, consumption is only 6.9 l at 90 km/h, 8.6 l at 120 km/h, and 14.9 l in town, going to 8.4 l, 10.8 l, and 15 l with automatic transmission.

Electronics to the Rescue

While the lightening, aerodynamics, and the new high-compression heads are responsible for many of the low consumptions, the improvement introduced by the injection systems is estimated to be 5 percent. A more accurate delivery of gasoline and ignition cut-off up to 1200 rpm during deceleration, are the two major causes for these savings. As we shall see below, the cut-off technique is in fact one of BMW's major points in engine development, as is the on-board electronics.



A high-performance modern wind tunnel. This model, with a very good C_x of 0.19, is an experimental car.

Beginning with the 525i, and in addition to the injection, we find at least three new devices:

An indicator for oil change and maintenance intervals. For BMW, one kilometer in town is not the same as one kilometer on the road: in the first case, the engine is cold, works in spurts, and heats when stopped, while in the second case its effort is steadier and less taxing. Four sensors--engine rpm, distance covered, water temperature, and outside temperature--are connected to a microprocessor which differentiates between distances that place heavy demands on the engine, and those that are easier on it. This microprocessor controls dashboard lights which tell the driver when to change the oil or perform maintenance.

The advantage for the car owner is that maintenance can be performed on demand, in many cases less often than the regular traditional maintenances. The advantage for BMW is that the system can only be reset at the dealer with a special key!

Electronic heat control: two sensors provide for precise regulation of ambient temperature to selected levels.

Program test II: since 1976, owners of Series 7 BMW's can verify the condition of their vehicles. In 1981, the Series 5 have the program test II, which constantly checks the headlights, brakes, position lights, dashboard lights, oil and water levels, windshield wipers, and so on. A warning light goes on for any defect, and cannot be turned off until the defect is corrected.

Active Safety

In its concern to improve everything, the BMW studies group did not spare any effort: the front end continues the design of the preceding Series 7, and the rear train has been redesigned for better efficiency. In front, a sophisticated geometry (with variable caster) provides many advantages: anti-diving during braking, better steering control, greater wheel clearance allowing the installation of hard sidewall tires without loss of comfort. In the rear, the oblique triangle system is now fixed at 13 degrees (as compared to 20 degrees for the 518 and 525i, which retain the old axle) to maintain the smallest possible length and wheel base variations, contribute to good utilization of the available power, and eliminate under-steering.

As a direct consequence of adopting the double-articulated front end, the Series 5 can use the ABS system which is compatible with the X-circuit brakes and the high-pressure pump with accumulator, which unlike conventional power brake systems allows several brakings with the engine turned off.

Driving Aids

Those who want even more information in order to extract the most from their automobiles, will not be disappointed by the Series 5. An instantaneous consumption indicator is standard equipment on the 525i and 528i, and eventually will be on the entire line: fuel consumption is shown in liters, and is calculated on the basis of the gasoline brought to the engine. With a precision of 5 percent it outperforms all the consumption indicators that depend on pedal depression alone, and it can be further improved with the on-board computer offered as an option by BMW, along with its electronic tachometer. In closing the option chapter, it should be added that Michelin has earned a salute for the selection of its TRX 60 wheels and tires.

One Step Further

As spectacular as they may be, all the technical innovations made on the Series 5 are ridiculously timid compared to those that are being prepared by the Munich designers; and yet, the directions of their research are guided by a strong sense of practical realism.

For instance, BMW has demonstrated that an excessive expansion of gear ratios is ultimately counterproductive for obtaining low consumptions. BMW's will therefore have only conventional overdrive fifth gears, while awaiting gear boxes—in a distant future—in which the shifting will be electronically controlled on the basis of many parameters such as speed, load, road conditions, and so on. It will thus be possible to always drive with the lowest consumption, and to select with one finger the type of driving desired: normal, economical, sports, and so on.

Because of the large amount of information which it can handle, such a computer could practically control all mechanical functions such as injection, ignition, and engine power.

The Cut-Off

Having observed that all driving ultimately consists solely of accelerations and decelerations, BMW believes that it would be desirable to modulate the available power. How? By working only a portion of the engine.

We were able to test the LZA system on a six-cylinder engine which operated on only three cylinders below 1200 rpm, and whose ignition was actually cut off during deceleration: we fortunately had signals to indicate whether we were driving with six, three, or zero cylinders, because we would not have known it otherwise! Even more impressively, the TZA allowed us to reach 130 km/h with a 323 operating on three cylinders; the other three, disconnected, were maintained at the right temperature by recirculation of exhaust gases. Except for a few vibrations, the performance was satisfactory with 25 percent fuel savings: a touch on the accelerator, and the punch of the six cylinders was instantly available.

Independently of these spectacular tests, BMW is working on all fronts, including that of turbo diesels.

This original engine research must not mask the essential effort: BMW is working like all the other manufacturers, to improve aerodynamics and reduce weight in its products. In the aerodynamics field, it is redoubling its efforts to catch up, and has even built a full scale model of an experimental car whose C_x equals 0.19, and which is equipped with movable parts leading to fruitful discoveries.

Up-to-Date

France has designed some new weather testing chambers which will make it possible to progress more rapidly in building new climate-control systems. As to weight, it was shown that the famous law--100 kg reduction equals 1 l per hundred kilometers gained--is false: a Series 3 lightened by 100 kg and with its engine subsequently optimized, improves by 5.4 percent in town and 5 percent on the road, which is not bad. In terms of weight reduction, BMW is trying everything, absolutely everything that is industrializable, is not demanding of energy, and has a reasonable cost: judging by the number of models built in Munich, the problem has been thoroughly examined in the area of light metals, as well as for plastics and sandwich materials.

As the last feature of serious research, BMW is also developing its investigative techniques, as demonstrated by remarkable holograms which disclose certain vibration phenomena. They may have been used for the new drive shaft of the Series 5, whose own frequency is so low and accurately calculated that the car is much more silent at high speeds. The quality of design is often the invisible detail which results in substantial gains: as we have seen, BMW has nothing to fear in this respect and remains one of the unchallenged leaders of automotive technology.

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West Europe Report

SCIENCE AND TECHNOLOGY

No. 81



FOREIGN BROADCAST INFORMATION SERVICE

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13 November 1981

WEST EUROPE REPORT SCIENCE AND TECHNOLOGY

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BIOTECHNOLOGY

BRIEFS

BELGIUM SUBSIDIZES BIOTECHNOLOGY--The Belgian government has developed a financial support program for research in biotechnology. It will enable Belgian industry to build up capacities rapidly and develop the technologies required for Belgian firms to successfully compete in world markets. The new initiative expands previous activities of the regional Belgian governments in this area. [Text] [Duesseldorf EUROPA CHEMIE in German No 24, 1981 p 407] 9160

CSO: 3102/10

ELECTRONICS

NORWEGIAN MINICOMPUTER FIRMS EXPANDING RAPIDLY

Duesseldorf VDI NACHRICHTEN in German 11 Sep 81 p 25

[Article by B.W.: "Increased Production of Minicomputers in Norway--Computer-Based Mapping Systems Succeeding"]

[Text] "We are small, a bit crazy, but good." This is how Per Aarsted, vice-president of the Norwegian Export Council, characterizes the Scandinavian data and communications industry. Indeed, those who have witnessed the high level of development of the Norwegian firms can only conclude that in reality Norway stands for much more than just fish, crude oil, wood and midnight sun. It has succeeded in building up a vital industry with an extremely high degree of automation accompanied by improved production efficiency.

Recently established companies--e.g., Norsk Data AS, Oslo, which is aiming at becoming one of the five largest suppliers of minicomputers in Europe; Stentor AS, Trondheim, manufacturer of in-house communications systems, which by its own account is the leading company in this market; or Tandberg Data AS, Oslo, which came out of the Data Division of Tandberg Radiofabrikk in 1979 and concentrates on the functional design of its display terminals in compliance with operational and ergonomic requirements--are obviously pursuing a clear course of specialization. Their philosophy is to find market gaps and fill them with products that are competitive worldwide.

It is evident that small companies can, in fact, finance the necessary investments. In addition, companies of this size (Tandberg Data, with annual sales of 107 million kroner; Stentor, with annual sales of 74 million kroner; and Norsk Data, with annual sales of 313 million kroner) have proven to be more flexible; for instance with regard to shifting to new products, as has been demonstrated in Norway. Their managements, consisting largely of young, enthusiastic people, have contributed greatly to the success of these expanding businesses. The growth rates of the companies named are between 30 and 45 percent.

Certainly, excessive specialization also holds dangers. In an attempt to partially circumvent this risk, exports are spread to many countries. The reason given is that the entire market thus becomes less susceptible. It is obvious, however, that the FRG is the main target of the majority of the Norwegian data and communications companies. It appears that they do not fear competition from Japan and the United States. The Norsk Data management says that the main competitors in Europe

are the national manufacturers. In this connection it is observed with obvious suspicion how some FRG public agencies award their orders. There have been several negative experiences with fund allocation for university computer centers which wanted to award their orders to Norwegian firms. This was prevented by "influential persons." A study by Karl Georg Schjetne of Trondheim University quotes total annual sales by Norwegian producers of computers to be 1.8 billion kroner, with 4,200 employees. According to this study, exports constitute 60 to 70 percent of this figure, and the growth rate achieved in recent years has been between 20 and 25 percent.

A totally different strategy from that of the companies mentioned is being pursued by a more conservative firm, AS Konsberg Vapenfabrikk, Konsberg. Konsberg is not relying on one specific product area; the data division ranges in mid-position with an 11 percent share in sales. This company stresses cooperation with companies from the FRG. According to the company, cooperation with Messerschmitt-Boelkow-Blohm (MBB) in the field of computer-aided cartographic systems has proven successful. "Norway needs the FRG," Per Aarsted says, "and the FRG needs Norway."

9544

CSO: 3102/6

ENERGY

ELECTRON BEAMS IMPROVE EFFICIENCY OF SOLAR CELLS

Frankfurt/Main ATOM + STROM in German Jul/Aug 81 p 124

[Article by of: "Electron Beams Improve Efficiency of Solar Cells"]

[Text] An electron-beam generator for short-term thermal treatment of the surfaces of solar cells has been developed in the Karlsruhe Nuclear Research Center (KfK). This short-term tempering is of major importance for the cells' efficiency in converting sunlight into electrical energy. Furthermore, the new electronic-beam generator promises a highly economical performance of this major step in mass-producing solar cells.

The solar cells now envisaged to be mass-produced mainly consist of monocrystals of silicon, a semiconductor, in which the foreign atoms are accommodated in very low and precisely controlled concentrations. The incident light releases electrons with negative charges and positive charges--"holes"--in the silicon, which are separated by means of the electrical effect of the accommodated foreign atoms and result in a usable electrical voltage. One well-known technical application of this principle is the light meter in cameras.

For physical reasons the maximum efficiency of such semiconductor elements, i.e., the relationship of usable electrical energy and incident light energy, is approximately 20%. Efficiency rates achieved in practice are now at about 10% and are largely dependent upon the quality, i.e., the flawless structure of the crystal lattice of the light-sensitive surface layer. A prerequisite for high quality is thermal treatment--tempering--of the surface, which has the effect of healing the crystal flaws caused by the accommodation of foreign atoms but does not cause a redistribution of the foreign atoms through diffusion. Because of physical properties, the tempering can be short-term only. Similarly, such a procedure is the prerequisite for cheap solar-cell mass production because it permits continuous treatment of large areas with low energy requirements. Short-term electronic beam pulses of a certain energy density, which do not penetrate deeply into the semiconductor layer and which cover a relatively large area, lend themselves to this purpose, but it had so far not been possible to produce them.

For this purpose the KfK's Institute for Applied Nuclear Physics (IAK) developed an electron-beam generator with the characteristics required. The electron beam has a variable energy of 10 to 25 kilo-electron-volts corresponding to the required depth of penetration of up to 1,1000 mm. The pulse duration is about 3/10 μ s, the

current densities in the beam are 1000 to 3000 A/cm², and the pulse energy stored in the material is variable between 0.3 and 2.5 J/cm². The diameter of the electron beam is approximately 5 cm at the location of radiation. These operating data are unique in the field of electron-beam technology.

The development in the IAK lasted some 2 years and cost approximately DM 80,000. Laboratory testing of the equipment was successfully completed. At present it is being used by interested parties for the test-manufacture of solar cells. Its further development is aimed at industrial applications.

9544

CSO: 3102/6

ENERGY

BRIEFS

COMMERCIALIZATION OF SOLAR TECHNOLOGY--Paris --Creation of "ELF Solar Energy Development." The "ELF" company announced on 9 September the creation of an affiliate devoted 100 percent to the industrial and commercial development of the results which "ELF Aquitaine" has obtained from several years of research in the energy field. This company named "ELF Solar Energy Development" will carry out the group's activities in the sectors of thermal and photovoltaic applications of solar energy and will develop its program on an international scale. [Text] [Paris AFP Sciences in French 10 Sep 81 p 42] 9816

CSO: 3102/434

INDUSTRIAL TECHNOLOGY

GOVERNMENT PROMOTES USE OF MICROELECTRONICS THROUGH 'MAP'

Paris ZERO UN HEBDO in French 14 Sep 81 p 24

[Text] It's not often that one can credit a government with having imagination.... However, this time, in Great Britain, there is a discernible effort. Since spring, and until the end of September, British stations one after the other are harboring along their platforms a train with five vivid blue cars bearing the letters MAP, which stand for "Microprocessor Application Project."

What's involved is a government financed plan to make businesses, especially small ones, aware of the advantages they can gain by using microprocessor technology.

The train includes two cars devoted to an exposition of microelectronics, with examples of applications in management and process control, and demonstrations of the possible use of microprocessors in the development of new products and the improvement of existing products.

The other cars are devoted to a micro-information laboratory, a conference room, and a reception room. The train spends a week in each of the 21 cities on its itinerary, and offers each time a complete range of various activities.

A Week in Each City

Day-long seminars, "Micros for Managers," are aimed at businesses with fewer than 300 people. The "Computing Services Association" holds meetings on the subject of the training required to carry out successfully projects calling for microelectronics. The systems installed on board can be reserved in advance by potential users, who can test them and later bring their real data. Finally, there are organized visits for school children and teachers, forums on the social implications of microelectronics, and even expositions on microelectronics, and even expositions on microelectronics for the handicapped.

All these things are manifestations of a 55 million pound program (MAP), preliminary studies of which had shown that it was sorely needed in Britain, since some 50 percent of British businesses had no notion of the possible benefits which microelectronics could have for them.

Progress is nevertheless being made. According to the latest figures published by the government, 134,000 people have already participated in the MAP meetings and seminars. Nearly 2,000 feasibility studies have been completed, and 90 to a 100 are being conducted each month. Moreover, the government has financed more than 450 development projects utilizing microelectronics, in all sectors, from agriculture to consumer goods.

Government Interventionism

One often hears it said that with Mrs Thatcher the British Government has become totally non-interventionist in economic activities. That does not correspond to reality, if one may judge from MAP.

There are other examples. In particular, financiers, who wish to invest in microelectronics but who are unable to appreciate the technical aspects, can call on government experts who will give them a technical opinion allowing them to make their decision. At the present time, 16 financial organizations have expressed interest.

9816

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INDUSTRIAL TECHNOLOGY

DASSAULT TO MARKET THREE-DIMENSIONAL CAD/CAM SYSTEM

Paris L'USINE NOUVELLE in French 24 Sep 81 pp 103-104

[Text] In deciding to market their know-how in computer-assisted design and manufacturing, the Avions Marcel Dassault-Breguet Aviation Company intends to take advantage of their highly interactive three-dimensional system which is somewhat ahead of the competition.

The decision has been made: Dassault will compete with IBM! This is being revealed by l'Usine Nouvelle. The news will make some noise: the Avions Marcel Dassault-Breguet Aviation Company, which has developed a solid reputation in the field of combat aircraft, has just made a 180 degree turn. They intend to market their know-how in the area of computer-assisted design and manufacturing (CFAO).

Mr Francis Bernard, head of the CFAO design and development department, explained this historic decision to l'Usine Nouvelle: "At the present time, we are 2 to 3 years ahead in this area. In these conditions, we had two possible strategies: we could keep our system and run the risk that sooner or later another one would become the industry standard. Or we could choose the opposite path, that is to market our system so that our work can serve as a reference in the future, and itself become the standard."

As we can see, Dassault approach is aggressive. The system they have developed, named CATI (Computer-Assisted Three-dimensional Design), breaks with the systems currently in use in industry. It does not operate in two-dimensional space, but truly in 3 dimensions. Thus, work which previously required 2 months, using conventional methods, now requires only 4 days using CATI. But the system's advantage does not lie in this characteristic alone. The ease with which the man-machine dialogue is carried out and the fact that non-specialists can use it too add to its attractiveness. This is due to the characteristics of the equipment as well as to the functions of the program. From the hardware standpoint, graphic terminals of the IBM 3250 type have been selected. The screen is updated instantaneously and permanently. The terminal system includes an alphanumeric keyboard-display use to work on data and display information such as coordinates or historical data. The program uses real-time versions of old batch programs developed through Dassault's experience with the "Drapo" system, including in particular the Lockheed Cadam program. This explains the close compatibility of CATI and CADAM.

The structure of the Cati program involves 3 logical areas. First is the monitor which is of interest primarily to the programmer. It is close to the IBM system and is written in assembler language and insures the independence of applications from the hardware. The application support includes all the conversational and system management tools necessary for the handling of elements in 2 or 3 dimensions. It is practically independent from the hardware and from the application programs and performs four major functions: data storage management, screen picture handling, management of the disk resident data base, and assistance for interactive procedures. The program handling the latter function includes several subprograms used in the third functional area: the application. Operator commands are kept to a strict minimum. Using the overall structure, the dialogue has been designed in order to reduce the amount of operator-training and support documentation needed, and the number of interactions in the application.

It is in the area of graphic applications that Cati differs most markedly from the competition and pulls ahead by several lengths. In its present state (the enormous 160,000-instructions program is constantly improved) Cati offers three main functions: definition of shapes, complex mechanisms, and manufacturing. As in the older RA 3D, Euclid, Systrid, or Unigraphics, shape definition is based upon a three-dimensional base concept. This is where the product is basically different from others limited to 2 or sometimes even "2-1/2" dimensions. Looking at the most sophisticated programs, one finds products such as Euclid designed to process three-dimensional shapes using the so-called "polyhedral" method where computation and handling of hidden surfaces are simplified by dividing volumes into small polyhedrons, and others such as Systrid where volumes are generated by complex surfaces. Processing is then performed on an exact digital representation of objects. Cati is an improvement in that it is the only one to use both approaches with the possibility to go from one to the other at any time and to use powerful mathematical tools (algorithms, resolution of intersection equations, etc.)

The second main function involves complex mechanisms and data processing. In this case, a mechanism is considered as a set of solids (previously defined) constrained in some manner (rolling, sliding, etc.) An advantage of Cati over the competition is that it allows the construction of a mechanism and its environment, motion simulation on the graphic screen to determine velocities, accelerations, and stresses. The operator is able to modify the geometry of solids and their linkages in order to optimize mechanisms. The last function is related to manufacturing. It is the tool used to prepare the numerical control machining of the geometrical elements stored in the data bank. There is thus a direct connection between the development laboratory and the machine floor which also exists in competitive products (Systrid, Unigraphics, etc.) It is to be noted that permanent visual control of the machining operation allows the operator to prevent errors and if required, to modify the geometry of a part to better adapt it to manufacturing processes.

In the light of this technical assessment, it is easier to understand why Dassault decided to go into the CFAO business. Cati is a high performance product and is practically complete. Its applications can be across multiple industries wherever shape-handling is required, such as the automobile industry, ship-building, aeronautics, architecture, civil engineering, boiler-making, etc. Cati is the result of at least 5 years of research and development. "The use of interactive data processing systems at Dassault goes back to 1975 that is, real-time graphic

systems. The use of computer design in the company goes back much further. It began in the years 1965-1966. The first aircraft to be designed using computers were the Mercure and the Alpha-jet" says Mr Francis Bernard.

Today seven plants of the Dassault group (Argenteuil, Biarritz, Merignac, Toulouse, Saint-Cloud, and the Generale de Mecanique Aeronautique plants at Seclin and Poitiers) use the Cati system. In all 70 to 75 terminals are used and it is estimated that about 500 persons are trained on Cati.

Dassault is determined to have the system in use outside the company:" by the end of the year, Cati will be available on the market, says Mr Francis Bernard, it is in operation in some test installations."

Naturally, the first Dassault customers want to announce their decision to purchase themselves. We may however reveal that four German companies (two in the aeronautics area and two in the automobile industry) are interested in the system. Mercedes-Benz will soon start using it as a test installation. The first French orders are expected soon.

So the CFAO war, that some do not hesitate to label the "fight of the century" which will decide the real industry leaders in the year 2000, has just started. By deciding to be first to go on the war path, Dassault has probably taken the advantage.

But the competition--mostly American--will certainly not stop there. Lockheed with Cadam, McAuto (a McDonnell Douglas subsidiary) with Unigraphics, Computer-vision, Applicon, Calma, Battelle (with Systid developed by the Aerospatiale Company), to name only these six companies, will certainly rise to the challenge.

6445

CSO: 3102/18

INDUSTRIAL TECHNOLOGY

BRIEFS

INCREASED AUTOMATION IN FRANCE--Even if CODIS [Committee for the Development of Strategic Industries] is destined to disappear, the Ministry's action in favor of production automation will be increased and even developed next year. The objective remains the same: within 3 years, to double investments in automation (3.5 billion francs in 1980). Thus the MECA procedure [Advanced Design Machines and Equipment] (100 million francs in 1981) intended for small and medium industries will probably be continued with an important budget increase. For large industries intending to develop pilot operations (such as flexible workshops), procedures will be simplified. Finally, part of the effort will be on research and training. [Text] [Paris L'USINE NOUVELLE in French 24 Sep 81 p 71] 6445

CSO: 3102/18

TRANSPORTATION

BELGIAN FIRM HOPES TO PARTICIPATE IN ATR 42 PROGRAM

Brussels LE SOIR in French 22 Sep 81 p 7

[Article by Pierre Bary: "The Belgean Firm, SONACA, Wants to Participate in New Civil Aircraft Programs"]

[Text] The specialized American periodical, AVIATION WEEK, announced this week that the Belgean firm, SONACA, is continuing discussions with AEROSPATIALE [National Industrial Aerospace Company] and AERITALIA for participation in the French-Italian ATR 42 aircraft program. Further, according to the American publication, the conversations are centered upon assigning to SONACA fabrication of the tail unit of that airplane, which is capable of transporting from 42 to 46 passengers, depending upon seat separation, over flight legs of about 1,300 kilometers.

Mr Claisse, assistant manager of SONACA, whom we questioned, confirmed that contacts had taken place, and are still going on, with a view toward participation in that program. But up to now nothing has been signed. Nevertheless a dossier is being prepared so that the government may be informed at the proper time. In the event of an agreement SONACA will need financing for its research and development work as well as for acquiring tooling.

Choosing the Right Horse

Mr Claisse reminded us that the company is seeking every opportunity to diversify its activity in the civil sector so as to break excessive dependence upon military orders. But, according to him, it is entirely a matter of choosing the right horse. The ATR42 is certainly a good project in the category of third level transport, particularly if one can interest the Americans in it, as there are good reasons for hoping. But SONACA does not intend to join that project solely, all the more so as there is still no certainty that this airplane will be built. Within the range of smaller aircraft (30 to 40 seats) there are two other projects worthy of consideration: the Canadian Dash 8 and the half Swedish, half American Saab Fairchild 340.

SONACA has also begun talks with these manufacturers for the purpose of securing sub-contracts which can contribute to maintaining its work load. The relative firmness of the dollar obviously makes its proposals more competitive.

Even though nothing is settled, SONACA indeed intends to enter the ranks, as Mr Claisse again told us.

Market for 5,000 Airplanes

The ATR42, for the construction of which a decision is expected before the end of the year, is going to occupy top rank in the range of what in the United States is called the "commuter" network. These airplanes, providing from 20 to 50 seats, serve to link medium size regional centers located off the mainlines of air traffic.

As we were reminded at the Le Bourget Aeronautical Salon, the aircraft of this category are undoubtedly less glamorous than of jumbo jets. But they no less meet a need of the market. At present there are more than 4,000 airplanes of this category--twin turboprops for the most part--in operation worldwide. And it is estimated that between now and the end of the century more than 5,000 must be produced to replace the oldest airplanes, which often date back more than 20 years, and to meet new market requirements. This has not escaped the notice of manufacturers, who have prepared numerous projects. The best known are those of Short Brothers in Ireland, De Havilland in Canada, Embraer in Brazil, Dornier in West Germany, Saab in Sweden and Fairchild in the United States, the last two having joined forces for joint construction of an airplane, and not to forget Fokker, which has continually perfected its F-27, of which nearly 1,000 units have been produced.

New Technologies

Such development would not have been possible without the perfection of new, higher performance engines which are therefore more economical in fuel consumption. It is to this task that the leading American engine manufacturers have buckled down--General Electric, Pratt and Whitney, Lycoming, Allison, and Garrett, not to omit mention of the French engine manufacturer, Turbomeca.

But it is the engines of Pratt and Whitney's Canadian division, whose power can range as high as 2,500 horsepower, with which the ATR42 will be equipped. In the basic version the engines will be of 1,800 rated horsepower, the maximum power not being required for the elongated versions.

When AEROSPATIALE interested itself in aircraft of this type it wanted to benefit from the experience which it had acquired with the Nord 262. It had at that time sketched out the project for an airplane of 40 seats known under its designation A535. In July 1980 it signed an agreement with the Italian manufacturer, Aeritalia, to develop a new regional transport airplane. In the beginning of 1981 the two partners, after contacts with transport companies, defined the ATR42, for start-up of which a decision is expected in the coming months.

The objective sought is to have recourse to the advanced technologies commonly used in "jets" in order to increase safety, reduce pollution, and provide greater comfort.

In the final analysis it is a matter of attaining more profitable operation, thanks to more efficient engines and simplification of the rules of operation.

Even though the French and Italian partners emphasized their intention of going ahead at the Le Bourget Salon, they have never concealed their desire to find a representative upon the American continent, which remains the main "commuter" market. Contacts have been made with several American aeronautical firms, among them Lockheed, which may take up a 20-percent participation in the program. On all sides it is considered that such backing could truly be the send-off for starting the ATR42, in which SONACA would then take part.

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CSO: 3102/2

TRANSPORTATION

FRANKFURT AUTO SHOW: LATEST PRODUCTION MODELS, PROTOTYPES

Paris L'ARGUS DE L'AUTOMOBILE in French 24 Sep 81 pp 1, 4-6

[Unsigned article: "Frankfurt, An Auto Show Facing the Future"]

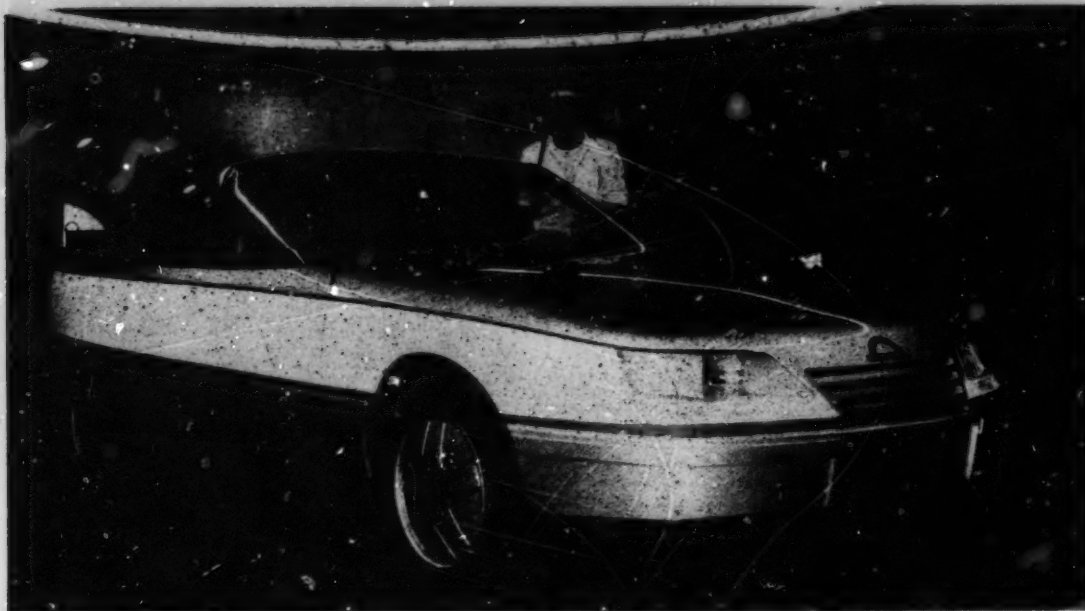
[Text] Colossal! No other qualifier can do justice to the attractions of the 1981 Frankfurt Auto Show, given the many new and varied discoveries that it offers. This odd-year show--with Paris having the honors of the even ones--has enjoyed a large number of world premieres: Renault 9, Opel Ascona, VW Polo, Santana, and Derby, Mercedes 380 and 500 SEC, Volvo 245 Turbo, Porsche 944, Fiat Argenta and Ritmo Abarth, Nissan Stanza, Daihatsu Charmant, and Toyota Celica XXI!

Already turned toward the automobile's industrial and commercial future, the show was crammed with experimental prototypes. It was not only the fulfillment of a research program launched in 1978 by the Federal Ministry for Research and Technology that made it possible for us to admire the likes of Eve and Vera, VW's Auto 2000, the UNicar of Karman associated with several German universities, a Mercedes experimental car, and Audi's prototype, unfortunately absent from the show; but most builders did not wait for official subsidies to display their own projects: Ford, with a remarkable Probe III (Cx 0.22); and Opel with a superb Tech 1 (Cx 0.24) on a Kadett base, so beautiful that we would want to see it on the street right away. Porsche went all out with a 960, an all-aluminum 928, and at the last minute, a 911 convertible coupe--turbo--with four driving wheels! Even the Japanese got involved: by means of a few sheets of aluminum for the body, and with the aid of a wind tunnel, Honda put together a Civic which is satisfied with only two liters of gasoline per 100 km.

Everyone presented devices for low fuel consumption, all the cars were crammed with electronics and microprocessors, while instrument panels became digitalized, complicated, and complemented with artificial voices (VW, Toyota) to warn the driver.

Beyond the hopes riding on good old piston engines, Frankfurt marked the return of gas turbines, and the prototypes being exhibited did not come out of tinkers' shops: what could be more serious than Daimler-Benz, Garrett, and Volvo?

And finally, proving (as if that was still necessary) that the automobile will never be relegated to the rank of utilitarian wheels, we had the convertible coupes. Honors to Fiat, whose Ritmo Cabrio will be mass produced, but



From the Opel Tech I ...



... To the Ford Probe III



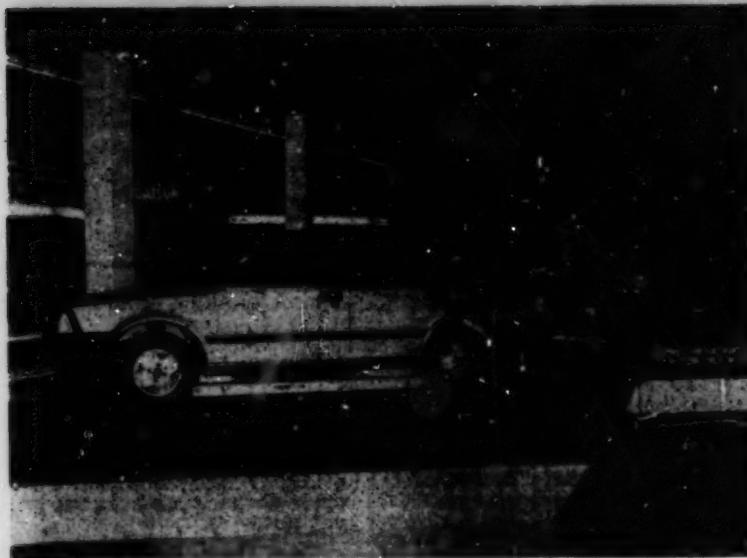
Engineers from throughout the world rushed to examine the Renault 9 in detail.

congratulations as well to Opel, whose styling department has very quick reflexes, and to Ford, whose Escort convertible prototype is simply superb. This revival, which so far has benefited only the VW Golf, was confirmed by the body designers; some of them have skilfully cut away Hondas and Toyotas to turn them into delightful convertible coupes. Show of the future as well as of imagination and technology, Frankfurt will be a significant milestone in the history of the automobile.

In Germany as in France, the automobile market is in the doldrums, and in Germany as in France, manufacturers are forging ahead, strengthening their technologic potential, constantly improving their products, studying, and creating new materials which will assure the commercial future of their enterprises. The first two photographs, which represent the very latest studies in aerodynamics and advanced designs, are examples of these efforts.

As Eberhard V. Kuenheim, chairman of the board of BMW AG, said at the press conference held for the Frankfurt show: "The German automotive industry has maintained its key position. That it has succeeded to do it in such difficult times, bolsters our confidence that it will be able to also do it in the future." But he also hints at some concern when he states: "The most important thing is to allow the mechanisms of the marketplace to do their work, and therefore to keep the interventions and prescriptions of the state compatible and at a minimum." This is an allusion to the demands of several ministries to obtain a reduction in fuel consumption as well as a new reduction in exhaust gas pollution.

The same reserve is expressed at Volkswagen, where Dr W. P. Schmidt, member of the board of directors, observes that car orders will have reached their lowest point during the summer of 1980, followed by a definite stabilization. And he adds: "We do not expect to see a significant reduction in sales in the months to come ... but unfortunately a number of factors are also slowing down a pickup in sales. Notable



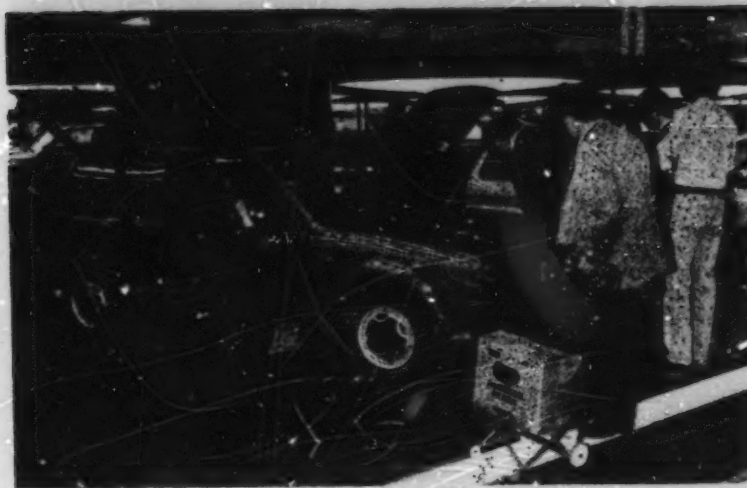
The Nissan Stanza was introduced simultaneously in two and three-compartment models.

in this respect is the purchasing power of households, which has been reduced by higher energy costs, as well as by the higher taxes and economy measures instituted by the federal government. Added to these are the charges created by the maintenance of high interest rates, and for company cars, the elimination of TVA (added-value tax) deductions, all of which are not without repercussions on sales. These factors have so far delayed the pickup of the demand for cars, which we could have expected under a normal market cycle."

As we can see, the lot of the Germans is no better than that of the French! And the figures confirm this precarious situation: during the first half of 1981, the production of German cars was 7.7 percent lower than that of the same period in 1980 (1,822,609 units compared to 1,974,728); exports were 9 percent lower (942,625 units compared to 1,035,277); and registrations were reduced by 5.1 percent (1,330,060 units compared to 1,400,968). This situation is practically the same as the one we are experiencing in France, the foreign penetration is 27.8 percent, or 2 percent more than in France.

While French vehicles are still esteemed in Germany, this year they are for the first time overtaken by the Japanese, who are capturing 10.2 percent of the market against 9 percent during last year, whereas the French moved from 9.8 percent in 1980, to 8.8 percent this year.

Renault and Peugeot S. A. are still the leaders on the German market. With 58,386 units registered during the first six months of 1981, Renault practically matches the Peugeot group (58,765 units, of which 25,431 Citroens, 16,947 Talbots, and 16,387 Peugeots).



Reappearance of utilitarian design in small cars: the VW Polo.

On the Japanese side, Toyota remains the first, but has reached a stable ceiling at 30,000 cars. On the other hand, Mitsubishi moved from fourth to second place with 27,944 registrations (+47 percent), overcoming Nissan-Datsun, which has lost 1500 units at 22,825 registrations, and Mazda, which is ahead by 1000 at 24,792 units. Moreover, Daihatsu is entering the market with 4846 registered cars compared to 1869 during last year, and Suzuki leaves its mark by increasing its share of the market from 1693 to 4026 cars. Competition is thus very strong even among the Japanese brands.

The fact remains that as a whole, foreign penetration did not spread in Germany and is stabilizing around 370,000 units at 27 percent for each of these two six-month periods. This is a testimony to the strong resistance of the German manufacturers, who are limiting their losses to 6.5 percent on a market where competition is quite open, and where the Japanese are not faced with the "3 percent law" as in France. The many new items presented by our Rhineland neighbors at this 49th Salon de l'Automobile in Frankfurt, should allow them to even better control their own market, and to provide better trump cards for their industry, which is resolutely facing the future.

A visit to the exhibits can only convince us.

Goodbye R 5 Alpine Turbo

The funniest moment during the opening of the Salon occurred Tuesday at noon, when the Renault brass, arriving from Paris, found a Renault 5 Alpine Turbo on the stand. As the reporters asked for details, the Renault management first believed this to be a monumental joke before changing their tune: the car was indeed there even though the release for the official presentation was scheduled for 25 September. The car disappeared within five minutes! On the other hand, the thousands of copies of the RENAULT JOURNAL, the sales brochure presenting the company's line, could not be made



On the left, the Opel Ascona; on the right, the Ford Escort. Convertibles have been very favorably received.

to disappear as well. And while the official information will be disclosed at the end of the month, the German public already knows everything about this R 5 Alpine Turbo, the direct competitor in all respects, of the Golf GTI. At a top speed of 185 km/h it is even faster than its German rival, it accelerates nearly as well, is undoubtedly more sober, and from all evidence will stop better: the question is whether it will hold the road equally as well. While waiting for this 110 hp bomb, the public was able to console itself with the Renault 9, continuously displayed and filmed by a skillfull and sometimes amusing robot. A good show for those who are fond of technology: the number of engines, transmissions, cars, and various other systems cut-away to show their innards, must be greater than that at all the other Salons combined! Also notable were some remarkable technical films, with the prize certainly being deserved by Ford, who really knows how to make accessible to everyone such difficult topics as aerodynamics or the finite elements method used for computerized body design.

Very Discreet P.S.A.

Presented before the Salon, Citroen's Xenia prototype was not well displayed at its stand. What's more, it was somewhat overshadowed by the competition of German experimental cars almost as advanced in style, but much more sophisticated in technology. A glimpse--was it deliberate?--of a certain Allemagne, a 2 hp in camouflage, with spare jerrycans, reminded us of the all-terrain calling of the dean of the Salon. Equally as funny was the Pony, a Mehari F.A.F., presented outside by the German Citroen license-holder: painted red, and already carrying its virgin license plates, it claimed to be ready for the Paris-Peking Rally, whose occurrence is still not certain! At Peugeot-Talbot (the Talbot name was not even mentioned on the official Salon plan, the two stands being assigned to Peugeot) both stands were combined, with hostesses in blue dresses wearing belts whose color alone indicated their Peugeot or Talbot affiliation. Nothing very new, except perhaps an exercise



Jealous of the Quattro, the Porsche engineers designed this special 911.

in style named *Presidence*, on a *Tagora* base. The name of the game is to install a radio, telephone, dictaphone, hi-fi set, and color TV set with teletext capabilities, in a top of the line SX equipped with power steering and refrigeration air conditioning: the *Tagora* becomes a director's office, but it is not known whether this version, so solemn that it is sad, will be on sale.

A last point which shocked a number of visitors was that no official sales literature was distributed at Peugeot-Talbot; the names and addresses of visitors were taken for mailings. This may be efficient, but it is unsettling and not likely to create an exhibit atmosphere.

VW-Audi in Force

A gigantic stand, which VW-Audi really needed in order to exhibit the entire line of current and future models. The newcomers, *Polo*, *Derby*, and *Santana* obviously were given the choice spots. The latter, while retaining the company's style, seems much more modern than the *Audi 80*, whose lines it reflects: a fine exercise in design! Noted on the stand: a *Beetle*, still being produced in some overseas countries, a stubborn symbol of the birth--before the war--of the "people's car" and of its extraordinary proliferation during the 50's. Standard bearer of the German economic miracle, the *Beetle* will soon be museum fodder: the West Germany of the 80's, with its unemployed and the difficulties of its major industries, already seems to regret those good old days.

Celebration at Opel

All the automobile builders have suddenly discovered that their products did not fit in with the energy and economy environment of our times. For purely weight considerations (let us not forget that vehicles are sold by the pound), the research departments have selected front-wheel drives. Opel made the choice in time for the remarkable *Kadett*, but the normal delay of new model design has deferred, for the



Highly streamlined, this Auto 2000 burns 3.3 liters of diesel fuel per 100 km.

users' taste and wishes, the arrival of the middle of the line Opel. The front-wheel drive Ascona finally made its appearance at Frankfurt, preceded by the flattering reputation of the engines which will power it. Mathematically, the smallest one, once named Junior and competing against Mini Metro and Polo, should also be available soon. As has been their good habit, the engineers of Russelheim have created a superb machine in which the engine and other mechanical elements give birth to a passel of models and versions. The Ascona, the future compact, and the millions of dollars invested in new plants, make it possible to forecast an Opel renaissance, for which the sales networks are rejoicing. From the number of visitors at the stand, the game seems to be well on its way for the German GM affiliate.

Creativity in the Major Leagues

BMW, Mercedes, and Porsche (in alphabetical order so as not to offend anyone) remain the major leaguers in technology: BMW starred the remarkable new Series 5, but found it difficult to present their electronics, their strong card, on the stand (which was ever so correct). By contrast, Mercedes used a wealth of turning mock-ups and transplanted test benches to visually convey the technologic image of the company with the three-pointed star. Porsche as well, poured on the technology with a Porsche 960 prototype, an all-aluminum 928, and masterpieces (in the true sense of the word) created by the company's apprentices, who cut up models to show their innards. The cream of the crop arrived late by air: a 911 convertible coupe with turbocompressor and four driving wheels. This remarkable prototype which Porsche will soon evaluate for an eventual sports application, encompasses the two big trends of the Salon: the return of convertible coupes and the teeming of experimental vehicles.



This Audi experimental model also reveals new manufacturing techniques.

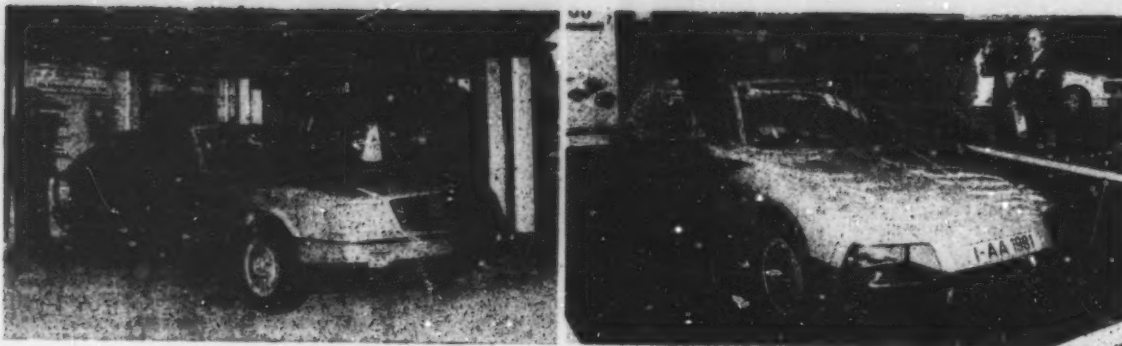
The Return of the Convertible Coupe

Thanks to Karman with the Golf, and to Triumph with the TR 7, we have rediscovered the pleasure of the convertible, fully convertible, without roll-bars, and with all the structural problems of rigidity inherent in a topless car. With the technology of convertible tops having progressed as far as that of air conditioning and heating, the ownership of a convertible is no longer synonymous with freezing in one's car in the wintertime. Consequently, a public eager to make the most of a car does not hesitate to buy what not so long ago appeared a folly. Fiat, having discontinued its 124 convertible coupe, has just joined the ranks with Ritmo Cabrio, for which the Turin designers had already drawn many convertible versions. At Ford, the Escort convertible version presented was only an exercise in style, but of superior effectiveness, with a metallized grey paint job and a squared back reminiscent of the one on the best-seller in that category, the Golf Karman. At Opel, the pretext is even cleverer: it is the first prize of a competition organized by one of our West German colleagues. The fact remains that a new trend is forming among the public, confirmed by the affluence noted at the stand of the Tropic company, who will cut up any nice Honda or Toyota and make it into an open air car.

Research

It was not only by chance that experimental cars were so abundant. In 1978, BMPT (Ministry for Research and Technology) launched a program for the car of the future.

Four projects were started under the responsibility of VW for a medium size compact, Audi for a medium size large car, Mercedes for a large car, and a group of German universities and research institutes for a more flexible goal.



On the left, the Mercedes experimental model accepts three engines. On the right, the Unicar built by Karman.

The two models of greatest interest to the driving public were extremely well conceived and built by VW-Audi (we will discuss them at greater length in a future issue). Mercedes presented a superb vehicle, although its very streamlined style, with a Cx of 0.30, was not unanimously well received. With a plastic body, an electronically programmed automatic transmission, ABS braking, a self-levelling hydropneumatic suspension, microprocessors almost everywhere, this large car weighing 1600 kg net, did not lack attraction. Even more interesting were its three engines: a turbo-diesel V6, a gasoline V8 in a light alloy, with cylinders that can be disconnected, and a gas turbine; they all had a power of 110 kW, or about 150 hp. With the turbine, normalized consumptions are 5.5, 6.7, and 14.2 liters of diesel fuel at 90 km/h, 120 km/h, and in town, respectively; those of the diesel V6, are 5.7, 7.5, and 9.8 liters, to be compared with 7.1, 8.8, and 12.1 liters for the gasoline V8. In all cases, the top speed is 200 km/h, and 0-100 km/h is reached between 11.5 and 13 seconds. A good accomplishment!

The University to the Rescue

UNicar is the fruit of the collaboration of four institutes or schools with unpronounceable names, which are more easily identifiable by their initials: they yield the equation IKA + IFT + FZD + FKFS = UNicar. Starting from ground zero, and blending economy and safety prerequisites, they have designed a new four-seater, weighing 1375 kg, equipped with a 2.5 liter four-cylinder engine. Their offspring looks like a Citroen CX station wagon, has a Cx of 0.25 (0.226 on the mock-up), and averages only 6.55 liters per 100 km. We will return to this interesting project, whose greatest merit is that it exists at all, given that the collaboration of the partners was not obvious at first.

At Ford: Probe III

Presented in Geneva and Turin last year, Probe II seduced us, because this project for an economical car was realistic. Frankfurt brings us Probe III, very well developed even though it is ugly. The basic idea was to achieve the equivalent of Taunus, but with half the Cx, or 0.22: the Merkenich (FGR) and Dunton (England) engineers have succeeded. What are the strong points of their research? In front,



The Uniroyal 280 completely reopens the question of the design and aerodynamic function of tires.

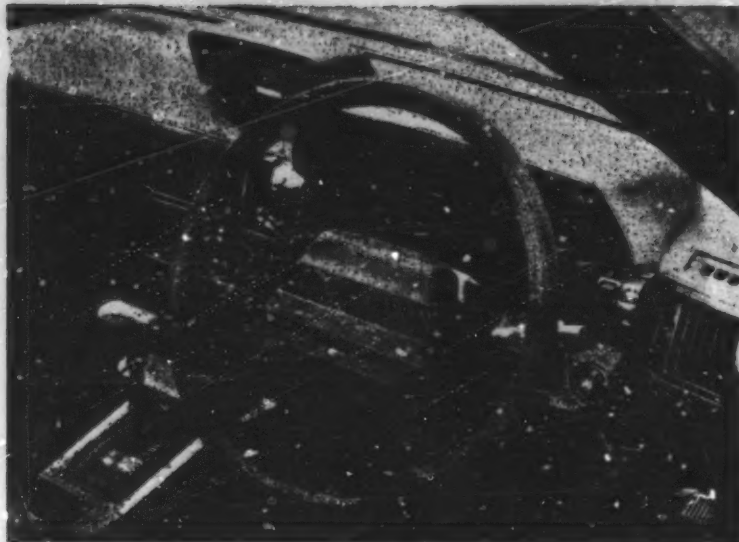
a movable spoiler is raised and lowered according to the engine's cooling air requirements, and is automatically raised during parking. In the rear, a double flap: its upper section operates normally, increasing the efficiency of the lower plane which prevents the updraft of air streams flowing under the Probe III. The lower fairing contributes to good performance: starting with a perfect single shape, the engineers have successfully divided it for accessibility to components, without losing any Cx. And finally, flexible plastic skirts cover the gaps between the tires and the body. For greater safety, the wheels have been covered with large flat hubcaps, and equipped with absolutely revolutionary Uniroyal prototype tires. Not only have their designers solved all the usual roadholding problems, but they have also studied the aerodynamic properties of tires. Whereas a conventional tire sucks air under the wheel to spit it out elsewhere, the Uniroyal does the opposite. Consequently, an aerodynamic vortex which disturbs the air flow near the body is no longer created: this is a first, both in aerodynamics and in tire design.

A Probe III will thus be able to transport four passengers at 170 km/h with the 68 hp engine of the Taunus, whereas the latter must be satisfied with 147 km/h. At equal speeds, the consumption will be infinitely lower. QED.

Opel, Porsche, and the Others

At Opel, the equivalent of the Probe III is named Tech 1. Just like its cousin, it is crammed with electronics and equipped with a digital instrument panel. Slightly less streamlined, a Cx of "only" 0.24, it has in exchange the fundamental quality of being pretty. It has nevertheless a variable geometry cooling air intake, but the choice of colors and the windows flush with the body go a long way to beautify it.

Whereas the Probe III is rather ponderous, the Tech 1 is sexy, much like a production model Kadett, and could easily be sold without disturbing the public. Compliance with various aerodynamic rules will undoubtedly cause future cars to resemble each other, especially since their bodies, derived from the same specifications and identically programmed computers, will also look alike. Nevertheless, Opel's styling department has shown that other solutions are possible, and that the function of design departments will be more important than ever.



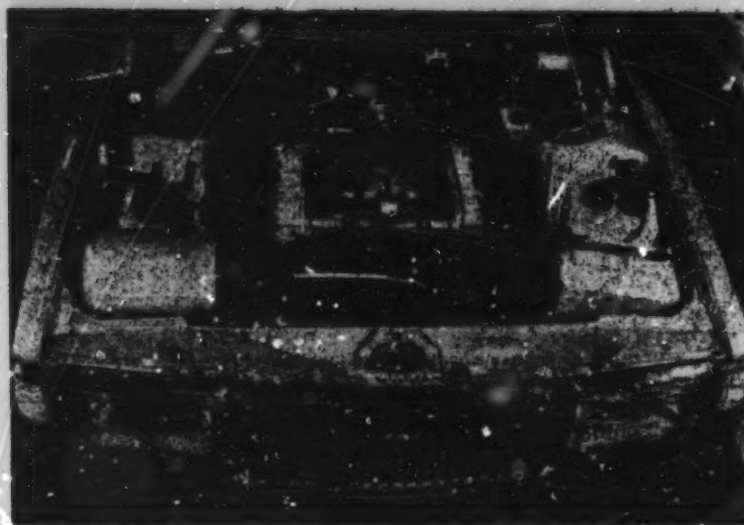
The triumph of microprocessors and electronics: the Toyota Navicom.

Porsche is also working intelligently on lightening, reliability, and engine optimization. They are placing great faith (like everybody else) in aluminum and fiber-reinforced plastics, and are producing results which will be discussed more extensively in a subsequent issue.

On the other hand, the discovery on a stand of a modified Honda Civic with a Cx of 0.28, calls for some comments. The purpose of the operation was to enter a fuel consumption contest for modified production models: called to the rescue, the parent company created this car, which is as efficient as it is ugly. This proves that the Japanese engineers have full scale wind tunnels and a sound knowledge of automotive aerodynamics: in the end, this very special Civic, running the Hockenheim circuit at 50 km/h on two cylinders, burned 2.077 liters of gasoline per 100 km, and was outclassed only by a Golf diesel, a very special one to be sure, with 2.031 liters of diesel fuel per 100 km.

A Little Bit of Everything

A world novelty, the Datsun-Nissan Stanza is interesting in more than one respect. A sort of large Mazda 323, it aspires to the status of world car, and has been introduced simultaneously in two and three-compartment versions. It will not reach France immediately, but the fall of the last bastion of rear-wheel drive is a milestone. When asked, the Nissan management defined its new philosophy, which boils down to: "Front-wheel drive up to two liters, and conventional propulsion for anything over that and for sports cars."



A highly developed gas turbine in terms of weight and size.

For the time being, this also appears to be the philosophy of Fiat, since the Ritmo Abarth (one more anti-Golf!) is equipped with the well-known dual-camshaft two-liter engine. At Ford, the XR3 Escort has been helped by a 1600 i Porsche with K Jetronic (mechanical) fuel injection and 115 hp (still another anti-Golf!), since the basic version, fundamentally still quite rudimentary, could not compete with the GTI. Its neighbor was the new RS, a turbo racing car, echoing the XR3 body but with rear-wheel drive.

Electronics Everywhere

The advent of inexpensive, reliable, compact microprocessors, has revolutionized automotive technology. These little chips have become a universal solution for all problems: they provide ideal control for ignition, injection systems, and transmissions, and they feed pre-digested and selected information to the driver.

In Frankfurt, the trend toward their generalized use was confirmed. Alfa Romeo showed a very sophisticated injection cut-off system; Toyota introduced its Navicom, a digital instrument panel which is so ingenious that an artificial voice assists the driver; and VW followed suit on its Auto 2000 prototype.

As for Volvo, it is still perfecting its Volvo Computer Control Turbo (VCCT), which enhances the efficiency of the turbocompressor by reading and controlling numerous parameters, such as consumption, pollutant emission, performance, and so on.

Return of the Turbine

Without VCCT, but with a turbine, Volvo presented the world's fastest station wagon, the turbine-powered 245, which exceeds 200 km/h and accelerates from 0-100 km in nine seconds! The most interesting item at this stand however, was a Series 2 equipped with a gas turbine under the hood. Following the setback with turbines of the most committed manufacturer in this field, Chrysler, it was thought that gas turbine projects had been abandoned. Together with United Turbine and Professor Kronogard, Volvo (assisted by the Swedish government) is investing heavily in a new turbine (with rotating exchanger) which should be operational in 1982-1983. Even spinning at 70,000 rpm and using advanced technology (ceramics) to withstand high speeds and temperatures, the modern turbine appears to be reaching an interesting stage of development from the standpoint of consumption, size, and weight.

This would also appear to be the opinion of Mercedes, which presented its gas turbine as a competitive alternative to the turbo-diesel V6 and to the gasoline V8 with cylinder cut-off (a system similar to that of Eaton-Cadillac). Well hidden in the Garrett stand, another gas turbine developed for NASA and Ford seemed to confirm the new direction of research, this time in terms of weight (Mercedes and Volvo) and size. In the opinion of its designers, the industrial technology for turbocompressors with hot turbines has made great progress in terms of methods, reliability, and price. As a result, gas turbines have regained some interest, especially since the weak point in the system, the exchanger, has also changed a great deal, both in terms of process (Volvo) and fabrication.

In summary, the highly technologic Frankfurt Salon really was the Salon of the future and of hope.

11,023

CSO: 3102/8

TRANSPORTATION

HYBRID ENGINE EXHIBITED AT FRANKFURT AUTO SHOW

Bonn DIE WELT in German 21 Sep 81 p 16

[Article by H.-P. Rosellen: "Revolutionary Engine?--The Stelzer System Consists of Just 8 Parts"]

[Text] H.-P. Rosellen, Frankfurt--Far removed from the established exhibitors stands a man at his booth in a corner of hall 6 at the Frankfurt Auto Show--a man who would revolutionize engine making, Frank Stelzer.

The 47-year-old from North Frankfurt lists on his registration card the profession of "inventor and designer." At his stand is a trailer chassis supporting a crude-looking iron block; it is what is known as a free-piston engine. From the block, which is about as big as two standard German postal packing cartons, a shaft projects to the left and right. Inside, the shaft is thinner and houses combustion chambers. Combustion impulses confirming to the two-stroke principle are generated by opposed spark plugs located in the center of the block. The impulses shove the shaft back and forth. "The construction is absolutely simple," explains Stelzer, "only the shaft moves."

The entire engine consists of only 8 parts. Stelzer: "In an emergency, even a housewife can put it together." The machine produces almost no vibration, and its fuel consumption is about 30 percent lower than that of conventional engines. Since no counter force is present, the shaft oscillates back and forth almost without resistance. Accordingly, less wear is experienced than, for example, in the case of an Otto engine piston. Since the shaft is hollow the device could operate as a pump.

This would be an ideal hybrid drive for automobiles. In this application, windings around the shaft would generate current which, in turn, would drive electric motors in the 4 wheels of the auto. With a total displacement of 500 cc, the exhibition piece produces 200 PS which would more than compensate for the energy loss along the transmission path to the wheels.

Stelzer has been working on his idea for 20 years. The lean man, who freely admits to being DM 2 million in debt, has tried again and again over the years to find parties in the auto industry with an interest in his patented system; however, in vain. An industrial engineer told him quite openly that it would be better for the auto makers to wait until his patent expires and then build the engine without paying a licensing fee. "Just in June I paid DM 95,000 to extend the patent protection," said the inventor bitterly.

Some important improvements on the new engine may still be needed before it is mature enough for production. For example, if one side of the ignition system fails, the shaft could shoot out with catastrophic consequences. But in any case the idea is disarmingly simple. Valves, connecting rods, cam shafts--all of the many hard-to-build parts are entirely absent from the Stelzer engine.

9160

CSO: 3102/10

TRANSPORTATION

RENAULT 9 FAMILY EXHIBITED AT FRANKFURT AUTO SHOW

General Description

Paris L'ARGUS DE L'AUTOMOBILE in French 17 Sep 81

[Article: "The Renault 9 Line: A Large Family"]

[Excerpts] A very modern car, the Renault 9 comes on the automobile market with many points in its favor. First of all, its design is traditional, with a three-compartment body. Elegant and discreet, to the extent that it does not especially attract attention among the sea of other cars, it should draw the broadest approval and not generate particular criticism. In addition, its size is reasonable (4.06 m long) while providing excellent room for five persons, with the rear passengers benefiting from the ingenious design of the front seats. The interior is very completely outfitted, and the presentation and finishing are very correct.

Mechanically, the Renault 9 remains faithful to front-wheel drive, with a transversal engine equipped with a gearbox located as an extension of the engine rather than above it, as in the Renault 14 which has an engine designed by Peugeot-Renault-Douvrin. The independent four-wheel suspension has a front-end with negative offset, and a rear-end with transversal torsion bars of a new design, which eliminates the previous design's wheelbase difference between the right and left wheels. The front wheels have disk brakes, and the rear, drum. So much for the general presentation; let us now look at some details.

The Renault 9 line consists of 11 versions, nine of which will be sold in France. The line is created by combinations of three engines, three gearboxes, and six levels of equipment.

The three four-cylinder engines are offered in two sizes: 1108 and 1397 cc. The 1108 cc engine develops 47.5 DIN hp at 5250 rpm, with a torque of 8.15 mkg at 2500 rpm; it is considered a 5 hp for fiscal purposes. It forms the C version of the Renault 9 line. The second engine, the 1397 cc, puts out 60 DIN hp at 5250 rpm, with a torque of 10.4 mkg at 3000 rpm. It is considered a 7 hp for fiscal purposes, and forms the L version. The third version uses the same engine, with its power increased to 72 DIN hp at 5750 rpm, and a torque of 10.8 mkg at 3500 rpm. It is also a 7 hp and forms the S version. It is likely that a fourth version will be introduced around next spring, equipped with the same engine; this time, it will develop 68 DIN hp at 5250 rpm and a torque of 10.8 mkg at 3000 rpm, and will have a three-speed automatic transmission. It will be called the 9 Automatic.

To the letters C, L, or S, which define the engine, will be added one or two other letters (T, GT, or TE) which refer to the level of equipment. This will create a line of nine models (for France), which will be offered at very competitive prices:

Version	Price
C	35,900 F
TC	37,700 F
GTC	39,900 F
TL	38,800 F
GTL	41,200 F
TLE	43,800 F
GTS	44,800 F
TSE	46,500 F

The price of the 9 Automatic has not yet been established, but it could fall in the range of the TSE.

The basic C version is already well equipped: windshield wiper with two speeds and intermittent sweep, wear indicator for brake pads, trunk light, central console, and so on. The TC, TL, and TS versions will additionally have a locked gas cap, arm rests on the right-hand front and rear doors, a storage compartment on the left-hand front door, a rear window heater, and so on. Also available at this level, are single-pedestal seats with longitudinal adjustment only (only the driver's seat is adjustable in the C version).

The GTC and GTL versions have single-pedestal seats with complete functions, a dashboard dimmer, trip odometer, oil level indicator, iodine headlights, back-up lights, rear foglights, and so on. The GTS version is recognized by its five-speed box, its aluminum wheels, and its rear spoiler. It also has a tachometer, oil pressure gauge, sport steering wheel, two horns, hot air duct to the rear seats, and so on.

And finally, the top versions TCE, TLE, and TSE, have a rear view mirror adjustable from inside the car, headlight aiming control, advanced finishing, and such options as electric windows, electromagnetic door locks, air conditioning, and so on.

What Are Single-Pedestal Seats?

These very comfortable seats belong to a new generation. They allow the front seat passenger to change position during a trip, and the driver to adjust the seat for best support under the knees: in addition to the usual longitudinal displacement and seat-back tilt, they allow the entire seat to pivot. The rear passengers thus can stretch their legs on each side of these centrally supported seats.

Three Economy Factors

We have seen that at the suggested prices, the Renault 9 is an economical car to buy compared to its competition.

It is also economical in terms of fuel. The 5 hp C series consumes only 5.4 l per 100 km at 90 km/h, 7.4 l at 120 km/h, and 7.1 l in town. For the 7 hp L series, consumption becomes 5.7 l, 7.5 l, and 7.4 l. With the S series, consumption drops to 5.4 l per 100 km at 90 km/h, 7.2 l at 120 km/h, and 8.8 l per 100 km in town.

The same is true for maintenance: engine oil is drained only every 7500 km, and the gearbox oil is changed every 65,000 km. The engine head no longer has to be tightened after delivery nor later, brake pads are changed without removing the calipers, front fenders are bolted on and thus easily removed, and so on.

Technical Details

Paris L'ARGUS DE L'AUTOMOBILE in French 17 Sep 81 pp 6-7

[Article: "First True World Car, Light, Economical, Well Designed"]

[Text] Love at first sight is also possible in technology: we cannot deny that the R 9 seduced us as soon as we first examined it, and that our European colleagues have also fallen under its spell.

In short, Renault has bet everything on design in order for this world car to be a Renault, without the usual shortcomings of Renaults. No more of the rolling in the turns, so dear to the R 5, and no more vague braking and stick shifting: the engineers have finally had the means to put an end to the black marks awarded by customers.

First car since the second oil crisis, the R 9 truly meets the specifications of the 1990's. The computer-assisted design has made it possible to reduce weight and therefore consumption. A transversal engine (finally!) leaves a larger passenger compartment for a competitive total length. The inside volume is remarkably well organized, with cleverly designed front seats allowing rear seat passengers the room to stretch their legs.

The engine is of matching quality: with no reservations, the old Cleon cast iron block of the R 5, with its lateral camshaft, has been reused because it is a miracle of economy. In conjunction with new heads, four or five-speed manual transmissions, or three-speed automatic ones, it provides a minimum of dash at 1108 cc and honorable performance at 1397 cc, but low consumption in either case.

The most interesting part is that the R 9 was designed for maximum robotized fabrication: not only have robots been entrusted with all cutting, stamping, welding, and body painting, but for the most time portions of the assembly will be performed without human intervention. The modernization of the Douai plant, where six automatic units for shell fabrication have been placed in service, exceeds the most recent Japanese plants: we are glad that Renault could match its competitors at the best price levels in the world, and fight them without having to resort to the anti-Japanese protectionist guerilla warfare that it recently launched in this country.

With original and efficient suspensions, and with great concern to facilitate repairs, the R 9 is consistent independently of the observer's standpoint. What are its weaknesses, then? From a strictly French viewpoint, we could reproach it its banal styling. But on second thought, this defect could well be an advantage in terms of world exposure, since only a body that is a common denominator for various tastes can assure its success. Moreover, its apparent platitude is nonetheless stamped with a fine balance, maybe even a classicism, which can be adapted to any market with a few minor changes.

In summary, Renault has invested with a free hand to achieve an excellent product and manufacture it at the lowest cost; let us hope that the world will welcome it warmly, and that sales and manufacturing forecasts will be fulfilled. The problem is that if a model as successful as the R 9 (which we sincerely believe it is) will seriously dent the competition, it will also weaken some of Renault's positions: how can we avoid thinking of the two-compartment cars of the R 9 and R 14 types, and of the two ends of the slot, the R 5 and the R 18.

Computers to the Rescue

It might be easier to understand the amounts of money invested in the study of a new model if we knew that the R 9 employed 500 people for 14,500,000 hours of studies and tests. More than 100 prototypes or "mules" covered 2,200,000 km in endurance tests, and the engines (even though their blocks are well known and produced in the millions) were run for 13,000 hours on the bench.

However, the proudest achievement of the research department is CAO (computer-aided design). Each structural element is calculated by the computer and shown on a screen by a series of lines which mean nothing to the uninitiated. But for engineers, all this work is essential: they can then visualize on their consoles the deformations of the whole. All of this is virtual, and graphically represents an impressive number of calculations. All the large manufacturers use such procedures, which make it possible to simulate the deformations and vibrations of parts which will never be built! This saves a lot of time, and a lot of money as well, since the first prototypes to be built will already have been tested by the computer's brain.

Making it Lighter...

The major advantage is that it permits the readoption of various design habits, and serious lightening of structures for equal strength. The second positive point of the method is that it tracks noises to their source by eliminating vibrations which generate noises, or by controlling them so that they will not amplify each other.

CAO has made it possible to define an R 9 which is basically very quiet, but especially very light (805 kg for the basic model!), particularly since there has been no hesitation to use high performance materials. Compared to their conventional counterparts, the weight savings have been 35 percent for the forward bumper, 12 percent on the front end (solely because of design!), 10 percent on the headlights (thanks to plastic shells), 12 percent on engine accessories, 20 percent on the differential, 10 percent on the idler gears, 25 percent on the wheels, 10 percent on the exhaust, and 15 percent on sound insulation.

Even more visible are the gains obtained on the rear seats (33 percent): they are now built of foam blocks (a technique adopted by Peugeot for the past 15 years!). As to the side and rear windows, they are now only 3.15 mm thick instead of 4 mm, lightening the upper glass portion by 20 percent, with all that this implies for road handling.

...Streamlined, and Safe

The three-compartment (or "three-volumes" cars, with an engine compartment, a passenger section, and a trunk), are known to be slightly less streamlined than the two-compartment or "two-volumes" cars of the type R 16, R 20, R 30, and R 14. The most recent research has shown that the shape and airtightness of the front, the absence of gutters (at least on the windshield risers), and the proper design of ancillary flows (engine cooling, air conditioning, ventilation) are nearly as important as the overall shape of the car. The basic version of the R 9 has a maximum cross-section of 1.848 square meters and a very honorable Cx of 0.385. The GTS and TSE versions, thanks to a rear spoiler, reduce the Cx to 0.37; this is quite remarkable since the recent European average has been about 0.40 (it had been 0.42 earlier).

Passive safety remains the same, even if it is no longer fashionable nor a sales point: the body is practically indestructible, with the front and rear parts absorbing energy when crushed as a result of deformable points having been inserted in the cross beams. The usual arsenal of retractable steering column, soft-edged interior decoration, 60 mm-wide belts (compared to the competition's 50 mm), is complemented by two innovations: front seats of a new design, and flexible bumpers with shock absorbers.

Important Innovations

The usual construction of steel-blade bumpers and laminated rigid bumpers, has been supplemented by an advanced approach consisting of:

A flexible polypropylene bumper with rubber attachments;

Polyethylene energy absorbers;

A multi-functional transversal beam connecting the side rails and supporting the absorbers.

The advantages of this construction are obvious: small shocks momentarily deform the bumper, which then resumes its shape. Heavier shocks are borne by the absorber, which can then be replaced to bring the whole assembly back to its initial condition.

Large shocks involve the entire structure, but Renault must be credited with an effort toward standardization by locating the front and rear bumpers at the same level.

And while the front seats fulfill a new concept in safety, they also offer a considerable advantage to the rear seat passengers by allowing them to stretch their legs on each side of the two slides, which are only 15 cm apart.

Why didn't anyone think of it before, we ask, thinking of the cleverness of the system. The engineers' answer is that this solution is very costly in terms of studies, and because it involves an entirely new design of the shell! We only need to imagine the stress placed on the metal when a 110-120 kg driver sits down and his movements are transmitted to a piece of sheet metal (thick enough, of course) through such a narrow area.

A New-Look Shell

Even if the ability and strength of robot welders is infinite, they nevertheless resemble humans: they work better if their task is simple. That is why the shell was designed with their capabilities in mind. For instance, the floor consists of two frame members, one in front and one in back, overlapping a central floor. The other elements are gathered around this base, where they are welded with great precision.

Light and rigid, this shell must furthermore be reliable over a long time period, and therefore protected from corrosion. Here again, nothing was stinted: depending on the degree of exposure to the elements, Renault used sheets pre-protected with a zinc layer, sheets which received two coats of zinc chromate paint or which were sprayed with zinc, and so on. The remainder, phosphating (with zinc, which is better than iron), passivation, cathaphoretic anticorrosion coats, are conventional and as good as the competition's best. The protection is completed with a PVC undercoating on the body, and with deposits or injections of caulking or waxy tars wherever there exists a risk of water retention in an end piece or hollow area.

Long Live Comfort!

These additions have a soundproofing effect, reinforcing that of the other elements installed on the body for that purpose. Tar paper cemented to the floor (which is conventional) reduces the propagation of vibrations, but special attention was given to the sound insulation of the passenger compartment by building a one-piece wall parallel to the metal wall which separates the engine from the passengers. Numerous silent blocks, as well as the lining cemented to the roof, contribute to the passengers' protection from noise. Rolling noises are well filtered, and aerodynamic ones are slight; as a result, the ventilation also had to be silent. This has been achieved rather successfully, as has the heating, which uses the principle of air mixing so as to improve progressiveness and the stability of adjustments. For once, the rear seats have not been overlooked (in top of the line versions, however), together with the existence of a pulsed fresh air supply. We will have to wait for winter to find out if this installation is effective, but we are betting that the "world" goals of the R 9 have caused it to be tested under all climates.

To close the comfort chapter, we mention again the single-pedestal front seats, whose curved slides make it possible to vary the seating angle. An additional advantage is that when the passenger wants to rest, the seat cushion tilts at the same time as the back: the thighs are supported, and this position, comparable to the one in relaxation armchairs, maintains the effectiveness of the safety belt, which is not the case when the seat back alone is tilted (the body can slip from under the belt).

Road Holding

In order to reconcile road holding, low cost, small size, and easy maintenance, engineers have been led to adopt solutions whose principles were well known, but which required very sophisticated design.

The front end is a "false" MacPherson design, so named because its triangle is formed below and is therefore much more solid. Associated with a negative ground offset (from 11 to 6 mm), a slight offset at the spindle (about 50 mm), a small caster angle (2 degrees 30 minutes), and an axial suspension stop (new, stamped out), the R 9's MacPherson design provides a high quality control linkage: the most important part however, is that all the elements, including the strong roll-bar, are articulated on a "false chassis" which also carries the engine; the latter is itself bolted to the front side rails, with various tie rods (tubular) that attach it to the shell, further enhancing the rigidity of the whole. It goes without saying that the idea is sophisticated, but the performance and reliability results are surprisingly good. Moreover, SNR (New Ballbearing Company), a Renault subsidiary, has created for the R 9 new insert bearings with two rows of balls (patented), and designed the famous axial stop which reduces the steering effort, as well as new bearings with two rows of conical rollers for the rear. At this location, the drum is attached to the axle with a collar and seal.

Less Roll

But the most original aspect of the rear suspension is unquestionably the two trailing half-arms associated with the torsion bars. This offers many structural advantages, but notably the fact that the two torsion half-bars are located exactly on the same axis and connected in a very ingenious manner. Here again, a great deal of thought had to be invested to conceive a rear-end that is as simple to manufacture, and especially one that performs as well for steering and tracking self-correction, and that reduces drifting and rolling thanks to an anti-banking bar.

But the driver could not care less about technology: he wants to drive a car that is comfortable, easy to handle, reliable, eye-catching. A road test of various R 9's (shod with Klebers, which are well matched to the R 9 suspension), under a full fledged downpour, brought out the car's most interesting points: easy, accurate steering, power, and especially, limitation of pitching and rolling. In our convoy, the R 9's performed better than a 2-liter Fuego and the 14 TS's running at the end of the pack! The quality of the suspension has two ancillary effects: braking, provided by Bendix Series 4 disks and calipers in front, and drums in the rear, is remarkable; and the great road holding capabilities of the R 9 make it seem underpowered. This is a characteristic of good cars (such as the basic Golf or the Opel Kadett), which we hope will eventually have the more powerful versions which they deserve.

Two Engine Sizes

For the time being, the R 9 is available in the 5 hp (fiscal) version with the 1108 cc four-cylinder, for the C, TC, GTC, and TCE models, with 47.5 hp at 5250 rpm and 8.15 mkg at 2500 rpm. The TL, GTL, and TLE models have the four-cylinder 1397 cc (7 fiscal hp) engine, with 60 hp at 5250 rpm and a torque of 10.4 mkg at

3000 rpm. Only the top of the line TS, GTS, and TSE have two carburetors: the 1397 cc engine then develops 72 hp at 5750 rpm and 10.8 mpg at 3500 rpm, with respective top speeds of 138, 150, and 160 km/h, but also with remarkably low consumptions. This three-compartment car, with a length of 4.06 m, a width of 1.634 m, and with four seats, consumes only 5.4, 7.4, and 7.1 liters for the 1108 cc; 5.7, 7.5, and 7.4 liters for the single-carburetor 1357 cc with four speeds; 5.4, 7.3, and 7.4 liters with the same engine and the five-speed box; while the two-volume with the 1397 cc engine posts 5.4, 7.2, and 8.8 liters at 90 km/h, 120 km/h, and city driving, respectively.

A single version of the two-carburetor, 68 hp (at 5250 rpm), 1397 cc engine has been designed to make better use of the five-speed automatic transmission. Its performance and consumption are not yet known, but they will be better than that of the GTS because of the heavier transmission and its slippage.

All-Purpose Block

The engine block is the cast iron Cleon of the R 5 and R 18. The consensus is that it surpasses in rigidity and losses the most recent injected aluminum creations. It might be a little heavier, but it is so rigid and reliable! The heads, however, are entirely new: first, because the transversal position is new for this block, and also because the company foundry and aerodynamics laboratory studies have advanced Renault's knowledge. Thanks to well controlled turbulence and better cooling of critical areas (sparkplugs, exhaust valves), the performance of new heads manufactured by the subsidiary Fonderies de Poitou near Chatellerault, is very good. Following the new trend toward intake at low flow rates, the camshaft is significantly shallower. The 1.4-liter engines have built-in electronic ignition in order to retain high performance and low consumption over long term usage; here then is an engine block designed many years ago, distributed for some ten to twenty years, which is easy to manufacture, and whose Cx of 0.37 and weight (between 805 and 845 kg in operating condition) facilitate its use.

A Well-Born Cradle

One of the last original features of this car--of which there is no shortage--is the presence of a "false chassis" or cradle in front. This solid parallelogram supports not only the engine, but the transmission, front suspension, and radiator as well. This assembly is so coherent that the front end can be aligned even before the cradle is installed on the car! It lends rigidity to the front side rails, but also fulfills many other additional functions: eliminates vibrations thanks to a very sophisticated silent block at the rear of the engine; improves control accuracy thanks to an anti-torque tie-rod which limits engine deflection; and especially, makes it possible for an assembly robot to install the engine without human intervention. The engine-transmission assembly is placed on a hoist which raises it and introduces it into the shell from below: only four bolts have to be tightened when the radiator butts against its upper location spring. This also should give an idea of the post-sale advantages of the car.

Easy to Repair

Renault is now much more concerned with post-sales work. It has finally followed the example of our German neighbors, where this requirement is much more prevalent. For instance, the clutch can be changed in a very short time, without removing either the engine or the transmission; other ingenious touches can be found here and there, but the general design of the body and mechanical components is satisfactory overall. And while the quality of finishing cannot be judged from prototypes, a real effort can be noted with the soundproofing of door jambs, electromagnetic locks, and water-spray windshield wipers (a patent bought from Ford) which are widespread in the United States, and which show the "world" orientation of the car.

All new, all beautiful. We shall see whether this R 9 keeps its promise in use, but we must admit that this car is full of good ideas at all levels. Renault has attacked the technical problems in the best possible way: the rest is up to the dealers, and they too, know their business.

11,023

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TRANSPORTATION

AUTO 2000 MAKES DEBUT AT FRANKFURT AUTO SHOW

Paris LE MATIN in French 18 Sep 81 p 16

[Article by special correspondent Philippe Hazan]

[Text] Engineers of the Volkswagen company have unveiled a technical achievement with the introduction, at the Frankfurt Auto Show, of an automobile still in the prototype stage that consumes 3.3 liters of Diesel fuel per 100 km: The Auto 2000. This is a performance figure never before attained by a Diesel engine, and marks the advance of the Germans in the field of research.

Of course, the Renault 9 stole the show from all the other automobile makers who exhibited at the Frankfurt Show (which will close its doors on 27 September). Of course, Opel's new front-wheel driven Ascona did not go unnoticed, and its competition against the Renault 9 for the title of Automobile of the Year will be strong.

However, it was another automobile that riveted the attention of many technical experts: The Volkswagen Auto 2000. A prototype whose design is based on the Golf, that consumes 3.3 liters of Diesel fuel per 100 km, and that is powered by an innovative 3-cylinder, Diesel turbocharged engine.

A closer examination of this model yields one surprise after another. To begin with, the supercharging can be effected either by means of a turbine-driven compressor or by the Comprex system that Ferrari used without success, at the beginning of the season, on his Formula 1 single-seaters. Of course, VW's is not exactly the same thing, but the principle is identical. Here, the Bosch ABS anti-locking brake system is mounted in a small car for the first time.

The instrument panel is a digital display unit with "voiced" warning signals to the driver in synthetic language! The "stop and go" system restarts the engine, which is automatically shut off during stops for traffic signals or traffic jams. Actually, although this VW 2000 is still in the prototype stage, it should not be considered a gadget factory.

The German technicians consider the required time span between invention and mass production to be very brief. In achieving a figure never before attained

of 3.30 liters per 100 kilometers at 90 km/hr (that is, less than 2.90 centimes per passenger kilometer!), Volkswagen has now overtaken the French engineers in the war of energy economies.

The latter are known to be working on the "3 liters of gas per 100 km in 1990" project that was handed to them in September 1990 [as published] by the minister of transport, based specifically on the Vera (Peugeot-Talbot) and the Eve (Renault 4). It is evidently easier to obtain record figures on a Diesel engine than on its gasoline counterpart, and there can be no doubt that the design and development departments of the big French automobile manufacturers intend to be exactly punctual at their 1990 rendezvous... .

9399

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TRANSPORTATION

VOLKSWAGEN, MERCEDES INTRODUCE NEW MODELS AT FRANKFURT

Paris L'ARGUS DE L'AUTOMOBILE in French 17 Sep 81 p 1

[Text] Among the many new models exhibited at the Frankfurt Auto Show, Volkswagen showed its 1982 Polo and Derby models and its 1983 vintage Santana. Mercedes unveiled its line of SEC Coupes.

The new break-bodied Polo, 3.65 m long (45 cm longer than last year's model) and 1.58 m wide (20 mm wider), offers more passenger space and a trunk whose maximum volume, rear seat folded down, is 1,000 liters. Featuring again the tested mechanical elements of last year's model, the Polo is front-wheel driven by a transversally mounted 1,043-cm³ (40-hp), a 1,093-cm³ (50-hp), a 1,272-cm³ (60-hp), or a 1,093-cm³ Formula E (50-hp) engine. Despite its station-wagon style body (close to that of the Metro), its Cx [aerodynamic coefficient] is 0.39 and its fuel consumption is remarkably low in its Formula E version: 4.8, 6.7 and 7.3 liters at 90 km/hr, 120 km/hr and in town respectively. It will be marketed beginning about mid-November.

The Derby is a small 3-volume model, 3.97 m long and 1.57 m wide, powered by the same engines as the Polo. The new body design and the raised trunk (540 liters, or 25 more than last year's model) give it increased passenger space and improved aerodynamics: Its Cx is 0.40 versus last year's 0.44. It will be deliverable in France in three finishes--C, CL and GL--in the spring of 1982.

As for the Santana, it will be October 1982 before this top-of-the-line limousine is seen in the streets of the Hexagon. It is 4.54 m long (same as the 505 and 10 cm longer than the Passat), and is powered by a 1,588-cm³, 75- or 85-hp, or a 1,921-cm³, 5-cylinder, 115-hp, or a 1,588-cm³, 54-hp Diesel engine.

The new Mercedes 380 SEC and 500 SEC Coupes replace the 380 and 500 SLC's, production of which stopped in August. Performance characteristics are again remarkable: Peak speeds of 210 and 225 km/hr respectively, while, thanks to a record-breaking Cx of 0.34 and a number of other improvements, fuel consumptions have been lowered by from 20 to 24 percent. Fuel consumption figures of 10.8 liters (380 SEC) and 11.4 liters (500 SEC) at 120 km/hr with elegantly styled

[Right]: Volkswagen's
1982 Polo.



[Left]: Volkswagen's
1982 Derby.



Above: Volkswagen's 1982 Santana.



Mercedes' SEC Coupe

Coupes capable of reaching 100 km/hr in 9.8 and 8.1 seconds respectively is a noteworthy achievement, but the gains are even more substantial in town: 13.9 liters (380 SEC) versus 19 liters (380 SLC) and 15.2 liters (500 SEC) versus 20.7 liters (500 SLC)--a striking accomplishment that illustrates Daimler Benz AC's mastery of the technology.

9399

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END

JPRS 79489

20 November 1981

West Europe Report

SCIENCE AND TECHNOLOGY

No. 82



FOREIGN BROADCAST INFORMATION SERVICE

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20 November 1981

WEST EUROPE REPORT SCIENCE AND TECHNOLOGY

No. 82

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BIOTECHNOLOGY

BRIEFS

RECOMBINANT DNA SAFETY REGULATIONS -- The Hague, 4 September -- The Social Economic Council [SER] is largely in agreement with the content of a draft Recombinant DNA decision from Minister of Social Affairs Albada. The draft decision provides regulations for the protection of the safety and health of workers involved in the preparation of recombinant DNA materials. These materials play a role in the determination of heredity. The SER notes that it cannot and will not make a judgement either on the social and ethical desirability and acceptability of DNA operations or on the policy to be conducted by the Department of Factory Inspection with regard to the admissibility of certain limitations. The draft DNA decision is based on the safety act of 1934. The decision mentions, among other things, that for each form of the recombinant DNA research and operations a report will be required. They are -- depending on the danger they may cause -- divided into two categories. Operations of the first category are announced by the minister and are prohibited, with possibilities of lifting the prohibition. The operations in the second category are permitted in principle, after a waiting period of 5 months following the announcement. During those 5 months, the Department of Factory Inspection will judge the nature of the operation. If the Department of Factory Inspection deems it necessary, special safety requirements can be imposed on the execution of the operation. The committee considered whether a general legislative ban on DNA operations would not be preferable, because the knowledge and risks connected to DNA operations are still so limited. A special lifting of prohibitions would then be necessary for every operation to be carried out. Because each proposed operation must be reported, the minister can be cognizant of developments in the area of DNA research. According to the committee, the combination of the reporting requirement and the waiting period and the possibility of completely prohibiting certain DNA operations, provides an opportunity to have a flexible impact on those developments. [Text] [Rotterdam NRC HANDELSBLAD in Dutch 4 Sep 81 p 9] 8463

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CHEMICALS

BRIEFS

NEW CERAMIC MATERIAL--London, 29 Sep--The British concern Lucas Industries Ltd, the manufacturer of automobile electrical components, brakes and other automobile parts, has established a subsidiary company to exploit fully the new ceramic material "Syalon." A great future is predicted for the material, which is a compound of silicon, aluminum, oxygen and nitrogen. Because of its hardness and heat resistance, it is expected that it will replace metals in many particularly high-stress applications. Presently, it is already in widespread use as a cutting edge, fitted to cutting tools in metal processing. It could play an even greater part in modern diesel engines and gas turbines, that is, for the engine and powerplant industry. Lucas has spent 1 million pounds sterling on the development of the material, more than DM 4 million. The new subsidiary, Lucas Syalon Ltd, will investigate the numerous possibilities for the material's use and establish contacts with processing companies. The possibilities extend far beyond the activities of Lucas itself. Important licensees for production operations so far are the American Kenna metal Inc and the Swedish Sandvik AB. Lucas itself produces the powder and some parts made from it. One great advantage of the new material is its good formability: Processors do not need to alter their previous forming techniques substantially. [Text] [Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 30 Sep 81 p 5] 9581

CSO: 3102/27

ENERGY

GOVERNMENT TO TAKE STAND ON LIEVENSE PLAN BEFORE 1982

Amstelveen ENERGIE SPECTRUM in Dutch Sep 81 p 220

[Article: "Government Wants To Make Recommendations on Lievense Plan Prior to 1982"]

[Text] On Thursday, 13 August 1981, on a motion presented by Minister of Science Policy A.A.Th.M. van Trier, the Council of Ministers decided to develop quickly a position on the "Lievense plan" for a Wind Energy and Electricity Storage Basin [WESP]. At the same time, it was decided to accelerate a few important branches of wind energy research, while starting exploratory studies on storage systems differing from a storage basin filled with water and on the integration of wind energy into the electricity network without storage system.

The government position is to be prepared by a policy group, consisting of representatives of the Ministries of Economic Affairs (president), Finance, Science Policy, Housing and Physical Planning, and Transport and Waterways. The policy group is to have a draft position ready prior to 1 January 1982, which will then be presented to the Council of Ministers via the National Planning Commission and the Council for Physical Planning and Environmental Hygiene.

The report must in any case address six separate issues:

- a further analysis of the significance of the plan in terms of energy supply and a further analysis of its civil engineering and technical aspects;
- a further examination of the financial-economic aspects related to the plan, among which the possibilities and manner of financing for the execution of a WESP;
- to begin an analysis of the consequences of a proposed storage basin and of wind parks on the water economy, physical planning, the environment, nature and landscape, recreation and fishing, as well as an analysis of the possibilities of absorbing these consequences, insofar as they are considered to be negative;
- a working out of the possible relationship between the construction of a WESP and the government plan to reclaim the Markerwaard;
- a proposal for the development of a phased government decision on a WESP;
- a detailed proposal for the regulation of organization and management involved in the development of the components of a WESP in close cooperation between government, electricity producers and industry. In this regard, information should be obtained as to how the foreign market could be approached with a chance of success.

The Council of Ministers further decided that two parts of the wind energy research would be accelerated: tip vanes and wind parks. The above mentioned policy group will make sure that this is done speedily within the framework of the National Wind Energy Research Program. With regard to the to be accelerated research project on wind parks, the electricity companies, the metal engineering and electro-technical industry and the technical colleges will have to cooperate in the development and construction of large capacity wind turbines -- 3 megawatts per turbine -- to be built by Dutch industry, as well as the related electrical systems to be coupled to the public electricity network.

Furthermore, the policy group will have to see to it that two additional studies are carried out; they are:

- a comparative study of a number of other possible storage systems besides the storage basin proposed in the Lieveense plan, as well as a study of a storage system smaller than the one proposed in that plan;
- a study of the use of wind energy in the electricity supply, where the main question is what share wind energy could have if no storage system is used.

These studies are financed through the budgets of the ministers of economic affairs and science policy.

8463
CSO: 3102/21

ENERGY

DENMARK'S WIND POWER PROGRAM REVIEWED

Stockholm SVENSKA KRAFTVERKSFORENINGENS PUBLIKATIONER in Swedish No 4, 1981 pp 3-13

[Article by chief engineer Jorn Keller-Jacobsen]

[Text] It might be tempting, by way of introduction, to expound on the energy situation in general and the Danish situation in particular. I will refrain from that. First of all, time does not permit this and, secondly, all this has been stated previously. Thus, I will proceed directly to the matter at hand and report that, by the end of 1982, around 100 million kroner will have been invested in wind power in Denmark, partly for research and development and partly in the form of state subsidies for the establishment of private wind power plants.

Just over half this 100 million kroner is going toward the development of large electricity-producing power plants and the rest to small private wind power plants.

Wind Power Program

With respect to financing, the development work on large electricity-producing wind power plants has been conducted with the cooperation of the Energy Ministry and the electric power plants.

The contribution of the electric power plants has been primarily in the form of personnel. In 1976 the question of initiating Danish wind power research was discussed by officials from the Trade Ministry (that was before we had an Energy Ministry) and DEFU. The ministry believed it was reasonable for the electric power plants to be involved in the development project in project management, planning, and financing, based on the consideration that, if research led to reality, it would be precisely the electric power plants that would construct and operate the wind power plants (figure 1). Of course, there were some skeptics at the electric power plants, but there was general agreement that, if money were to be invested, it would be best to use it in a professional manner! (All economic data in the figures refers to Danish kroner.)

Figure 2 shows what the money has been used for so far (in addition to 1 million kroner for aerodynamics studies in conjunction with a special research project). In addition to diverse theoretical studies that have led to a number of technical reports, concrete results and proof are now available in the form of two 630 kW wind power plants in Nibe near Alborg (a town whose name is probably not unknown to Swedes).

Energy Ministry	28.4 million kroner
Electric Power Plants	9.0 million kroner
DOE (United States), Gedser	<u>0.9 million kroner</u>
	38.3 million kroner

Figure 1. Financing: Wind Power Program of the Energy Ministry and the Electric Power Plants, 1977 - 1980

Gedser mill	3.0 million kroner
Nibe mills	25.2 million kroner
Siting research	1.5 million kroner
Measurements in Nibe	5.7 million kroner
Project coordination, etc.	2.0 million kroner
Other	<u>0.9 million kroner</u>
	38.3 million kroner

Figure 2. Wind Power Program of the Energy Ministry and the Electric Power Plants, 1977 - 1980

Nibe Mills

The wind power program of the Energy Ministry and the electric power plants was begun in 1977. According to the original schedule, both Nibe wind power plants (mills) were to be complete around mid-1979. We also had counted on a relatively short test period. Things did not go quite as planned.

Mill A was connected to the power grid in September 1979, i.e., 1 year after construction began in Nibe. Mill B was connected to the grid for the first time in May 1980. The present situation is that both plants have operated periodically with unmanned automatic operation, but they are not yet in regular service—even though both are ready for unmanned automatic operation for wind velocities up to 18 m/s.

The explanation for the long test period is a combination of many "childhood illnesses" and poor performance by some individual components. Progress was not facilitated by the fact that the manufacturer of the machine house declared bankruptcy. We have plenty of excuses and then some.

With regard to mill A, we somehow managed to reverse the phase sequence in the generator leads! This is a trivial problem that should simply lead to cutoff by the relay protection. This cutoff did not occur for some unknown reason. Instead, manual cutoff was necessitated, which took just long enough for a young engineer with adrenalin pumping through his veins to rush down the ladder on the machine house atop the wind power plant to the breaker on the bottom floor. Despite his record time, the generator was mildly damaged. It was prepared and the relay protection doubled.

The hydraulic system in the blade angle control system has caused some problems, in part because of a stuck servo valve—probably due to impurities in the oil. The hydraulic system was cleaned and the valve design modified.

Oil leakage was later found because the surface treatment of a piston rod did not live up to specifications. Of course, the piston rod was located in a critical and inaccessible position. The necessary grinding was made, the seals were replaced, and the wind power plant began operating again.

Several weeks later a bolt in one of the stays fell loose. This could have been fatigue failure and, for this reason, the remaining 23 bolts on the stay in question had to be removed and examined by magnetoflux and ultrasound techniques. They proved to be free of defects but, when corrosion damage was found in the broken bolt, all the bolts were replaced with more corrosion resistant ones treated with tectyl.

All this sounds banal and trivial--and it is. But it takes time, time, and more time to correct these problems.

The first large-scale examination of mill A was conducted in December last year after about 900 hours of operation. Everything seemed in order--except one small detail. Close examination revealed cracks in the welding of the stay mountings--clearly a manufacturing defect. The cracks were small and not visible to the naked eye. As a result, the vanes had to be dismantled. After a closer look at the dimensioning, it was decided that the stay should be replaced. This has not been done and the vanes will be in place within several weeks.

Of course, in mill B the same modifications have been made as in mill A, based on operating experience. This does not mean, however, that there have been no problems with mill B. The continuous blade angle regulation in mill B places great demands on the operating speed of the microcomputers, and it has proved necessary to alter the entire program structure (software) to meet these demands. On the hardware side, interference problems had to be overcome by altering the cable duct. I will mention only for the sake of completeness that the chip in the wind power plant's three microcomputers had to be replaced because it did not meet the manufacturer's specifications.

Now we hope that these setbacks are over. One of the purposes of the Nibe project was to gain practical experience in the design and construction of large wind power plants. From this standpoint, the project may be considered a success so far! In this regard, strictly speaking, we might hope for a little less success in the future. The above-mentioned setbacks occurred mainly at the beginning of a rather comprehensive testing procedure at various wind velocities, which have been considerably more time-consuming than we had assumed. The difficulty in predicting the wind strength makes planning more than several hours in advance practically impossible. This means that if enormous personnel resources--which was not permitted by our financial framework--the test period will be extremely time-consuming.

The process may be made much simpler if as much testing as possible is done in the workshop rather than at the site. In the same manner, the plant should be designed in such a way that assembly at the site may occur without disassembling components already assembled and tested at the shop.

Among other known problems, it may be mentioned that the blade tips on mill A experience considerable vibrations when the wind velocity exceeds 18 m/s. This apparently

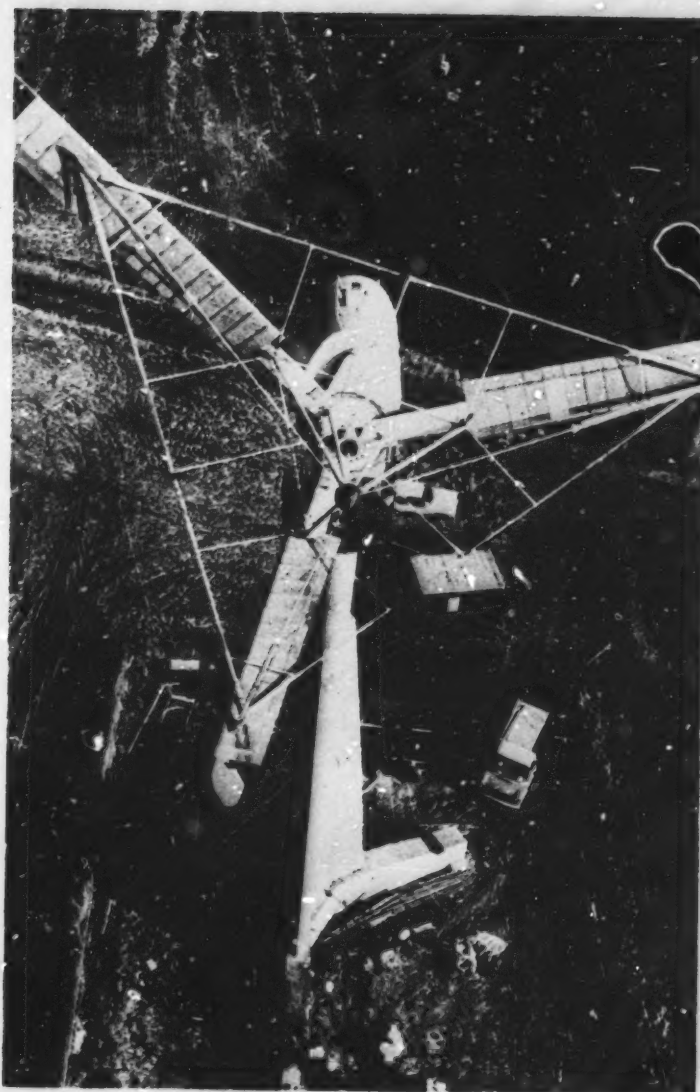


Figure 3. Gedser mill, repaired and in test operation

is because regulation is accomplished by stalling. If the operating range must be permanently limited to 18 m/s, the annual capacity would decrease by 5 to 6 percent.

In mill B, relatively high stresses have been discovered in a weld joint in the innermost supporting iron girder on the vane blade. By relative I mean in relation to the latest steel standards in which the permissible dynamic stress has been reduced due to the risk of fatigue failure. Theoretically, in any case, we cannot expect the 30-year lifetime for which we originally hoped. The weld joint in question is

being observed by placing additional pressure on the tubular iron girder and continuous pressure observations are being made.

Site Selection Studies

If extensive development projects for large, electricity-producing wind power plants are to be feasible, the physical capacity to erect a large number of wind power plants must be forthcoming. A percentage allowance to cover fixed costs must be made available in reasonable proportion to the amount of electricity that will be generated.

Our preliminary work has included compiling a "wind atlas," i.e., a mapping of wind conditions throughout the country with four wind categories, in which the wind energy in the lowest class is only 30 percent of the wind energy in the highest class.

The Kingdom of Denmark now has been mapped with regard to limitations on the site selection of wind power plants, with regard to legislation and public restrictions, with respect to environmental considerations, and finally with regard to the interests of agriculture.

This research is barely complete, but it is already clear that several thousand large wind power plants could be constructed in Denmark, even if the above-mentioned interests are respected. In this case, it is hardly likely that any of them will be in the highest wind category; and it is estimated that the average energy production will be 25 percent below the optimum value. This is said with every possible reservation. On the one hand, legislation and administrative procedures may be changed and, on the other hand, local conflicts of interest may arise during the actual site selection for wind power plants.

What Do Wind Power Plants Cost?

One question I can hardly avoid taking up is what wind power plants cost and whether or not they are profitable.

I showed in a previous figure that the Nibe mills cost 25 million kroner; but, of course, this includes several one-time expenditures. If these are deducted, along with the sales tax, which we had to pay, and mid-1980 price levels are used, initial capital expenditures would be 12,400 kr/kW (figure 4). The figure also presents possible savings indicated in preliminary studies. These estimates must be viewed with extreme reservations--especially when we speak of large turbine diameters, for example, 80 m.

The price at the bottom indicates the approximate equilibrium price we must achieve if wind power is to be profitable. The preconditions for profitability include a technical lifetime of 25 years, an estimated interest rate of 7 percent, and moderate price increases for fossil fuel (2 to 5 percent annually) calculated in fixed prices.

The profitability is defined in such a way that the expenditures for capital and maintenance match the savings in power plant fuel--approximately 15 ore/kWh--taking

Nibe mills	12,400 kr/kW
Further development according to Nibe design	15 percent
Series production	20 percent
Increased unit size	25 percent
Results	6,000 to 7,000 kr/kW?

Figure 4. Is it Possible to Reduce Initial Capital Investments for Large Wind Power Plants?

into account that the wind power is considered to have a continuous power output corresponding to 10 percent of the rated power.

Maintenance costs for wind power are an extremely open question. One usually speaks on the order of 1 to 5 ore/kWh. The upper limit for a wind power plant the size of the Nibe plants is just 75,000 kr/year--i.e., a major overhaul is permissible only at intervals of several years and repairs and preventive maintenance must be limited to an absolute minimum--this is particularly true for off-shore sites.

The Future of the Wind Power Program

As indicated, the Nibe project has not yet been completed. First, the wind power plants must be "polished up" and, secondly, an extensive measurement program will be conducted. For this reason, it has been decided to continue the wind power program during 1981 and 1982 (figure 5).

Further development:	turbine	4.5 million kroner	
	machine house	3.0 million kroner	
	other	<u>1.4 million kroner</u>	
			8.9 million kroner
Measurements and operation			3.0 million kroner
Site selection studies			1.9 million kroner
Administration, etc.			<u>0.6 million kroner</u>
			14.4 million kroner

Figure 5. Wind Power Program of the Energy Ministry and the Electric Power Plants, 1981 - 1982.

The major part of the expenditures for further development will go toward the machine house and the turban, which clearly are the major items for expenditures. With regard to the turbine, new turbine types must be developed and a more optimal turbine produced (for example, of pure fiberglass or the well-known wood design we have known for years). It is possible that the turbine in mill B will eventually be replaced since, as mentioned previously, there is some concern over material stress in a weld joint in this mill.

With the completion of the wind power program outlined here, a milestone will be passed at which it must be decided if and how we are to proceed.

Privately Owned Wind Power Plants

I have talked at some length about large wind power plants, which are not yet profitable. A word about the small, privately owned wind power plants might be in order. Today, there are 400 to 500 privately owned wind power plants in Denmark, of which just over half are connected to the power grid. Typical plants produced by about 20 manufacturers are on the order of 10 to 50 kW.

Is it profitable for wind power plant owners or is it simply enthusiasm for this steady energy source and concern over the Danish balance of payments that is behind these plants? The answer is probably both. An example will illustrate the economic side of the issue.

We will assume that the output of the wind power plant corresponds exactly to the electricity consumption of the owner. He uses 45 percent of the power directly at the same time the electricity is generated (figure 6). This portion of the output is worth the same price he must pay the electric company, including state and sales taxes. The rest is delivered to the grid and is purchased for the same price the electricity distributor pays the power producer, plus 10 percent transmission losses, plus a 50 percent reduction in the distributor's power costs calculated in terms of energy payments. Perhaps that sounds complicated but, in practice, it is incomprehensible!

The calculations may appear as in figures 7 and 8.

The calculations are even more favorable for collectively owned wind power plants, which also are permitted. The only condition is that the owners live no more than 3 km from the wind power plant. In this case, up to 55 to 60 percent of the owners' needs can be met instead of the above-mentioned 45 percent.

If the output of the wind power plant is used completely or partially for business purposes, there also is a complete or partial reduction in sales tax when a wind power plant is purchased!

Conclusion

Here I conclude my little presentation on wind power development in Denmark where interest in wind power is great--despite various setbacks--among both politicians and the public.

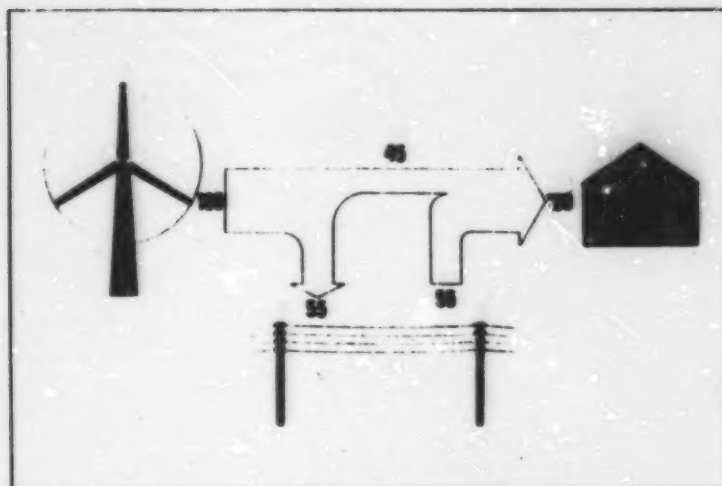


Figure 6

22 kW Wind Power Plant,
Annual Production 40,000 kWh

Price	210,000 kr
- 20 percent state subsidy	<u>42,000 kr</u>
	168,000 kr

Figure 7

Annual cost	
20-year loan	33,100 kr
- tax benefit (55 percent)	17,700 kr
+ operating costs	<u>2,000 kr</u>
	17,400 kr ca. 44 ore/kWh
Cut in expenditures during first year	
$64 \times 0.45 + 27 \times 0.55 =$	44 ore/kWh

Figure 8

The Danish program for developing large electricity-producing wind power plants chose to begin with medium size plants where we could rely on more or less known technology. We did this on the assumption that we would certainly encounter enough problems--problems that could not even be imagined in the planning stage. Our experience indicates that our timidity was probably well founded.

The Swedish national wind power program has proceeded directly to gigantic wind power plants. It will be interesting to see how this goes; but, because of the renown of Swedish industry, there is every reason for optimism. In conclusion, I would like to wish you good luck in this great venture.

(During the lecture, a clip from the film produced on the Nibe mills was shown.)

9336

CSO: 3102/1

ENERGY

RAINS CAUSE PEAT SHORTAGE FOR DISTRICT HEATING PLANT

Stockholm NY TEKNIK in Swedish 10 Sep 81 p 2

[Article by Ulf Bergmark]

[Text] This summer's heavy rains have led to a catastrophe for the Skelleftea power plant's peat mine in northern Vasterbotten. Only 6,000 m³ fuel peat could be mined of the planned production of 25,000 m³. When the municipality's peat-fired district heating plant begins operating this winter, therefore, it will be necessary to use much more wood than previously estimated.

The rainy Norrland summer was literally like a cold shower for Swedish peat experts. The drum shredder cutting technology that the Skelleftea power plant purchased and several peat producers in Norrland are expected to use, has worked well in Finland for many years. In Norrland, however, the technique is now being reexamined.

"Finland has a more inland climate with sunnier and drier summers. When it rains the peat cannot be harvested," production manager Ingvar Johansson said at the Skelleftea power plant.

Sun Dried

The drum shredder cutting technique means that a thin layer, 1 to 2 cm, is cut from a large area of peat. This pulverized peat is then sun dried before it is collected in mounds. The drying requires sun and days without rain and, for this reason, the production season is short and dependent on the weather.

"We have now learned that we cannot count on normal summers. We must somehow guarantee a fuel supply even during rainy summers," Ingvar Johansson said.

One way to meet requirements is to increase the bog area on which the peat is mined. This requires more personnel and, for this reason, the peat would be more expensive. The power plant is also considering contracting with farm owners who can deliver wood chips during rainy years.

Rotary Kiln

In the long run, however, a completely different production technology is needed. A technique that is independent of the weather has been developed by the Hyrovag Company of Skelleftea (NY TEKNIK 1979:39).

It will now be tested in Fargelanda in Dalsland with support from the Oil Replacement Fund. The method involves digging up the peat with power shovels and then drying it and making it into pellets in a rotary kiln. The Skelleftea power plant is awaiting the results before it replaces the Finnish peat cutting machines.

The 7MW district heating plant in Skelleftea will begin test operations in December. The 6,000 m³ peat produced this year and the 12,000 m³ produced last year when mining began is not even sufficient for this winter.

120 Hectare Peat Bog

Next year, when the plant is in full operation, 50,000 m³ peat will be needed. By next summer, the amount of peat in Rojnoret 40 km from Skelleftea, will be expanded from 50 to 120 hectares. This will be far from enough, however, if next summer is just as rainy.

"The peat we produced this summer we gathered in a day and a half in June. Since then it has only rained," said farm owner Ivar Lindblom, who worked for the power plant this summer.

"If we had begun in May, which was unusually dry and sunny, perhaps we could have harvested the 25,000 m³ peat as planned," Ivan Lindblom said.

"If it were not for road construction and preliminary work toward uncovering new areas, we would hardly have had any work here this summer," local manager Elfrid Eriksson said.

9336

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ENERGY

FRENCH SOLAR POWER PLANT NEARS COMPLETION

Stockholm NY TEKNIK in Swedish 17 Sep 81 p 14

[Article by Gunilla Norbro]

[Text] France's first genuine solar power plant is now nearing completion. The power plant in the Pyrenees is to begin operating at the end of February or beginning of March next year. It is 1,700 m above sea level in a region with 2,400 sun-hours per year. The estimated power will be 2,500 kW.

In April 1977 the French government decided to construct the first solar power plant in the country. In May 1979 orders to the contrary were issued--the project was considered too expensive. The initial estimate of 94 million francs was now revised to just over 128 million francs.

As early as June that same year, however, the government reversed its decision and gave the go-ahead to the project.

The French solar energy office, COMES [Solar Energy Commission], created Cnesol, a solar research center that would study high-temperature cycles with various types of molten salts.

Cloud Detector

At the solar power plant, Cnesol will be responsible for measurements, calculations, and tests. The site will be in direct contact with five meteorological stations. There will also be a cloud detector, an instrumentation platform to determine the amount of incident light on the heat-absorbent material, infrared cameras, etc.

In this way, it may be seen whether or not the results agree with the accepted theories. Components and decisions by technicians can also be tested.

Two Stages

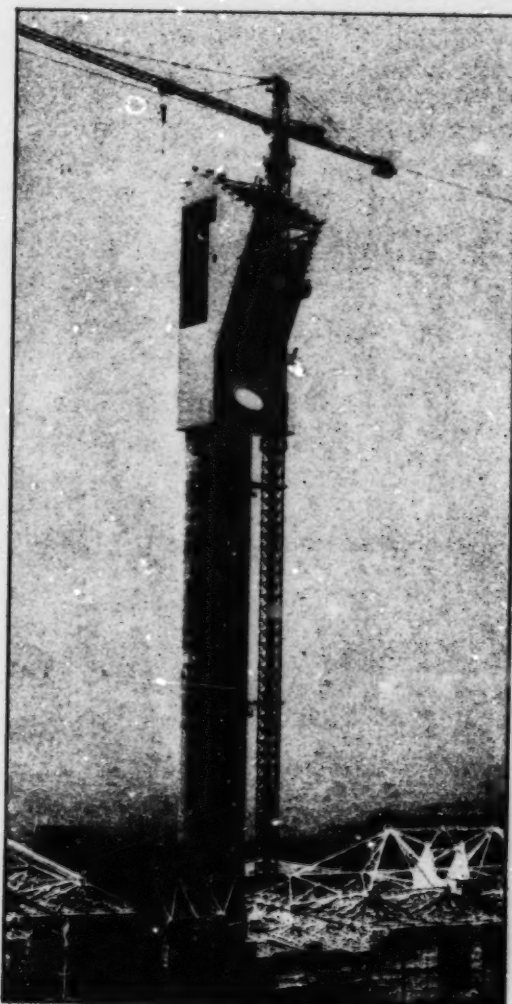
Cnesol's work is decided into two stages. The first, which is now underway, includes the construction of a double heliostat field (mirrors that reflect the sun's rays toward the receiving tower), a tower, a research laboratory, and a plant. In the second stage, the facility will be capable of being repaired without being shut down. This will be made possible by the construction of a second tower.

The French power plant will be more than twice as large as its Italian counterpart on Sicily which began operating last summer (see NY TEKNIK, 1981:28). The Italian plant produces 1,000 kW electricity.

Boils Water

The common principle for both plants is that a large number of mirrors heat water in a tower, after which the steam drives a turbine. The surface area of the mirrors in the French plant is 10,740 m², while in the Italian plant it is 6,200 m².

As at the Italian plant, the French plant has a heat storage consisting of salt. The storage is needed to keep electricity production at an even level, even if a cloud should pass over the plant.



Solar power plant in Targassonne in the Pyrenees, tower with mirrors turned downward in foreground. In a second stage, an additional tower will be constructed.

9336

CSO: 3102/20

ENERGY

BRIEFS

POWER PLANT PLANS CANCELLED--Plans for a residual oil power plant on the west coast have been cancelled. The project was a joint effort involving SP Technology, Svenska Petroleum, and the State Power Board. It was to be fired with gasified, high-sulfur residual oil (see NY TEKNIK, 1980:39). The State Power Board has not backed out, since the high-sulfur oil has become too expensive. [Text] [Stockholm NY TEKNIK in Swedish 10 Sep 81 p 4] 9336

CSO: 3102/20

SCIENCE POLICY

PLANS CONTINUE FOR INCREASED CIVIL RESEARCH BUDGET

Paris L'USINE NOUVELLE in French 15 Oct 81 p 87

[Text] Research: A "Return to Standard" Budget. Next year, the government will authorize an exceptional effort in civil research and development. But one must wait until 1983 to discover the new directions of its science policy and of its incentives for industrial research.

In 1982, the civil research budget will be increased by 29.6 percent; it will go from 19.6 to 25.4 billion francs. It is a decision which marks a quantitative break with past trends. For almost 12 years, the percentage of the GDP [Gross Domestic Product] earmarked for research and technology expenses in France stagnated at about 1.8 percent. By the end of next year it should reach 2 percent, and in 1985 the objective is to reach 2.5 percent. In constant francs, this is the same as going from 50 to 80 billion francs in 5 years.

A year ago Pierre Aigrain, secretary of state for research, was talking of a "catch up budget" when he announced a growth of 17.7 percent. Today, Jean-Pierre Chevenement, minister of state for research and technology, alludes to "a budget for research equipment restoration and for getting 'back to standard.'" For the time being, that is the extent of his ambitions. A boost in employment (the creation of 1,727 jobs), the strengthening of support credit for the programs and equipment, and an increase in financing for the important technological programs constitute the main trends for 1982.

However, as far as the major lines of advance are concerned, one finds the traditional biotechnology, electronics, robotics, and energy. Jean-Pierre Chevenement explained: "It is only at the conclusion of the far-reaching debate that will terminate the National Conference on Research and Technology next January, that we will be able to define some precise directions and some topics to get us under way."

The Driving Role of Public Enterprise

No change in the government's science policy will therefore be discernible until 1983. This will be equally true for industrial research which will only increase from 6 to 7 percent in volume this year. "The new terms concerning financial incentives, the reform of technical centers and measures for strengthening traditional sectors sacrificed by the state up till now--particularly engineering--

cannot be put into effect before next May or June," Jean-Pierre Chevenement declared. In the meantime, he is basically counting on nationalized or nationalizable businesses. They guarantee more than half of the 21 billion francs set aside for industrial research, which itself represents 40 percent of the national research effort.

Already, he has informed himself of their research and development programs and is preparing for the setting up of a "ministerial board of directors" which, among other things, will oversee the execution of the planned contracts which these businesses will submit to the state.

For lack of a new orientation, those sectors that are in the forefront are being strengthened. Out of 25.4 billion for the civil research budget, 9.1 billion are reserved for the major technological programs (69 percent are administered by the Ministry of Research). For the first time, authorizations for electronuclear programs (1.4 billion) will be largely exceeded in 1982 by civil aeronautics (2,078) to allow for the development of new Airbuses and energy efficient engines. And even by space applications (1,418). Far behind, the computerization program, whose budget nevertheless will be almost doubled, and sponsorships in the area of oceans which are to be increased six times over! As far as the allocations for research are concerned, of which 77 percent is financed by the Ministry, they are to increase by 26.4 percent (32 percent in the authorization of programs) and will permit the building of major scientific equipment already planned (fusion reactors, synchrotron).

At this rate of growth, the government's bet could be taken. No doubt it would only be a first step. For other countries also are intensifying their efforts in research and development. Notably Japan, which is aiming at 3 percent of the gross domestic product in 1990 for civil research alone!

9824
CSO: 3102/23

TRANSPORTATION

FOKKER VERY OPTIMISTIC ABOUT MDF-100 PROJECT

Huizen AARDE & KOSMOS in Dutch Sep 81 pp 530-533

[Article by Hans Engelman: "MDF-100 Propelling Fokker Toward Greater Heights"; passages enclosed in slantlines, printed in italics]

[Text] The starting gun has been fired. The salesmen from Fokker and the American airplane factory McDonnell Douglas have taken to the road to present the basic design for the MDF-100 to the airline companies.

Following the signing, on 1 May, of the memorandum of understanding by both airplane manufacturers, this is the first joint operation related to the new project. The future will depend on this sales operation.

/"The first clients -- the launching customers -- are very important to the carrying out of the project."/ These words were spoken by Fokker Director Krook, who knows what he is talking about. Because, having been loaned to Airbus Industry, following a difficult initial period he managed to lift the European Airbus A-300 over the threshold. Now he is back, leading the sales team at Fokker.

"In the past, we designed and built a complete airplane and then took it to the clients. But this is no longer possible. In terms of the definitive design, potential clients have an important voice in the matter," said Krook.

"There are a few companies which dispose of very capable design and study departments themselves. And when these airline companies finally make a definitive choice by signing the first contracts, this is very important because it will automatically draw other companies across the line."

Krook named the KLM [Royal Dutch Airlines] as one of the air carriers whose judgment and choice are valued. But also Swissair. And in the United States, two giants such as United Airlines, the largest in the West, and Delta Airlines, the richest.

"Even if they only conclude a first order for 10 units, you know that more will follow, that in fact you are talking about 100 or 150 units."

Krook also believes that in the future one should only sell a bare airplane. Without engines. "Let the clients themselves negotiate with the engine manufacturers." Three companies are in the market for the new 150 seater: General Electric and CFM, Pratt and Whitney, and the combination Rolls Royce with the Japanese Aero Engines Ltd.

If next all three manufacturers market a type of engine for the MDF-100, then a fixed choice would only have disadvantages for the airplane manufacturer, who would then be completely tied to and dependent on the engine supplier, and for the client, who could bargain for much better purchase prices through his own negotiations.

Fokker and McDonnell Douglas

It is due to a large extent to the ever increasing costs incurred by the airlines, that in a relatively short period of time a market has been created for an advanced airplane which would be capable of transporting some 150 passengers over short and intermediate distances, at relatively low operational costs.

Fokker, which has been working for a long time on preparatory studies for the F-29, and which was looking for partners to carry the risks for this project, came in contact in this respect with McDonnell Douglas, which had plans on the drawing board for a DC-11.

At first, the Americans were not interested at all in cooperation with the Dutch mini-airplane manufacturers. But it was thanks to Fokker President Swarttouw that in the spring, following 6 weeks of tough negotiations, the management of the American company changed its tack. It was primarily the convincing power of the top man at Rotterdam Fokker, which convinced the Americans that cooperation would offer better perspectives than "everyone for himself." As far as Swarttouw is concerned, it is indisputable that virtually no single factory can afford any longer to begin the development of a new type of airplane.

During the last 2 years, Douglas, the civilian branch of the American concern, has seen the sales curve of the DC-10 go down, and even the new version of the DC-9, the "dash 80" model, is only slowly getting off the ground -- in spite of positive reactions from the first buyers. At Douglas, things were more difficult from a commercial point of view, while Fokker, following its withdrawal from its West German merger partner VFW [United Aeronautical Works], registered growing results.

Furthermore, it was obvious to the Fokker negotiators that the new market would provide room for only two manufacturers, each of whom could have a profitable share of it. Cooperation would provide the best opportunities for both factories to grab a share of that market -- it has been estimated that it will be possible between now and the mid-nineties to sell 1500 to 2000 airplanes, and the same number again afterwards.

Dance of the Competitors

Precisely 1 month before the largest air show in the world, the "Air and Space Show," was to take place in Paris, Fokker and McDonnell Douglas announced that the two manufacturers had mutually agreed on the joint development, construction and sale of a 150 passenger airplane for short and intermediate distances, the MDF-100.

The announcement, which had been kept quiet as jealously during the period of negotiations as a state secret, struck like a bomb. The competitors had prepared themselves for Paris, where traditionally nearly all the manufacturers brought their news. Hence, the response came on the first day of the air show, which is traditionally also reserved for the international aviation press. Immediately following the opening of the show, Fokker and McDonnell Douglas gave a first press conference, during which their cooperation was once again emphasized by the presence of both presidents, Frans Swarttouw and Sandy McDonnell, and it was further announced what people from both companies would be working on the new MDF-100 project. Immediately afterwards, the management of Airbus, led by Bernard Lathiere, was in line to announce, in response to the MDF-100, that Airbus Industry would proceed with the development of, among other things, the Airbus A-320. Two days later, it was announced that Air France had signed a temporary agreement for an order of 25 A-320's, with an option for another 25 units.

After all this bellicosity at the beginning of the show, Boeing had very reluctantly presented itself as the third competitor in the market for the 150 seater, with its design for the 7-7. /But,/ both Boeing representatives said, /"the plane will not be ready before 1987, because the engines will not be available before that."/

Boeing's caution is understandable, because the Seattle factory is already working on two new projects, the 757 and the 767. For the time being, it appears that the latter design will be a greater success than the smaller 757. And even though financially speaking Boeing could easily stand a small loss, they first want to wait and see how matters will develop, especially now that the less flourishing economic situation is also affecting the airplane industry, as clients are reluctant to buy new airplanes. Hence, they prefer to just await developments before stepping definitively in the dark hole of a new project.

It is also clear that the airlines greet competition by various clients with pleasure. They are very chary of a development whereby Boeing would dominate the market for a 150 seater, and would thus more or less hold a monopoly position on the market for larger passenger airplanes and would thus be able to dictate the sales prices.

Airbus Problems

For the time being, the battle seems to be concentrated between Fokker-McDonnell Douglas and Airbus Industry. But this European factory, in which the French speak loudest, is faced with the problem of development financing. The other major partner in Airbus Industry, the FRG, has already announced that for the present time it does not have any surplus money for new projects. They first want to see a return on the earlier investments. And it looks as if the British and the Spaniards will also be less liberal than they were with the other Airbus projects.

Furthermore, the intergovernmental committee, in which the countries participating in Airbus regularly exchange ideas, has not yet discussed the future A-320 project, let alone made decisions about it. With the actually premature announcement in Paris, it looks as if the French wanted to put the other partners in a situation such that there was no going back.

Hence, Airbus Industry is busily looking for risk bearing partners for the A-320 design. At the end of June, there were rumors that General Dynamics, the builder

of the F-16, was interested. The company holds the largest number of defense contracts in the United States, and over 20 years ago it was also involved in the construction of a civilian passenger airplane, the not very successful Convair 880. General Dynamics confirmed that "exploratory" talks had been opened with Airbus Industry. But a week later, the top man at Gernal Dynamics, David Lewis, had already announced in St Louis that his company saw better opportunities in other fields than civilian aviation.

And thus, the opportunity for Airbus once again to penetrate the American market via an American partner, was temporarily lost.

Fokker Know How

Fokker brings a great deal into the cooperation with McDonnell Douglas. In addition to the 800 million guilders in government support for the development of the project, there are the many research hours put into the F-29. The F-29 wing designs alone involved 7000 wind tunnel hours. And, in addition, there are numerous other studies. In recent months, the Dutch and American airplane designers have slid their blueprints on top of each other. They hope to have the final design ready in November. At that time the marketing teams will also be back with the wishes of their clients, and then it will be possible to put the technical dots on the i's. The Fokker people are expecting the first orders before the end of the year.

By that time, the points of contention must also have disappeared. The Americans want to concentrate exclusively on a 150 seater, but with regard to the preparatory studies for the F-29, which was designed for 130 passengers, the marketing people discovered that there is also interest in this version. In addition, there is a failure to agree on whether one or two aisles would be desirable. But Fokker Director Krook believes that it is the client who must ultimately determine what he wants.

Aside from the intensive technical and commercial activities, the financial people are looking for a third partner in the project, and they are thinking especially about the Japanese. The cooperation, which has been achieved between Fokker and McDonnell Douglas is based on complete equality, on a 50-50 basis. What share would be assigned to a third partner has not been determined. /"This depends on the negotiations. I could imagine it being 40-40-20,"/ said sales manager Krook. According to him, the battle will have been fought by the time of the signing of the launching orders. /"One of the three will be at a disadvantage. If success stays away, Airbus will go bankrupt. Boeing will not build if they are out."/

And Fokker? President Swarttouw has always said that the company needs three projects. Next to the still successful F-27 and the F-28 in which interest keeps growing (the production for the next 2 years has been sold out), another design is essential. This was the F-29; it has become the MDF-100.

But the engineers are also already working on new design studies for the F-XX, an advanced turboprop airplane, based on the F-27 concept. And the marketing people are cautiously testing the market to find out whether there is any interest and what the requirements are.

American Market for Netherlands

Now that Fokker has gone to sea with McDonnell Douglas for the MDF-100, the opening into the American market has also been accomplished. And yet, the Dutch airplane factory will operate cautiously. The F-27 and the F-28 have also already found their way to American clients. And 6 months after having put them into service, the users of the F-28 have already made money. Hence, Paul Quackenbush, president of Empire Airlines, a commuter line in the vicinity of New York, is very happy with the Fokker jet planes. In noise sensitive New York, the airplanes fully meet the strict noise abatement standards. And he told us that, based on his experience with the Fokker product, he is also very interested in the MDF-100.

In order to reach the American market better, a new company was set up last year, Fokker Aircraft U.S.A., with headquarters in Washington D.C. In order also to provide American users with technical support concerning components, a distribution center has been established in Texas, and around the middle of 1983 a training center for F-28 pilots will be opened in Tampa, Florida.

Fokker: Good Future

Optimism is great at Fokker. Not mistakenly, considering the interest which Fokker also enjoyed during the Paris air show. "We are actually selling airplanes here," said one of the Fokker salesmen enthusiastically, "that has never happened before." It was even a question of hurrying to get a favorable place in the production line. Consequently, the Fokker management has decided to increase its production of F-27 and F-28. And because of the increasing value of the dollar, the company is even picking up a little extra. Now that economic recession and high fuel costs are making high demands on the industrial economics of the airline companies, many of them have found the way to Fokker which, with its F-27 and F-28, has two planes for a market which appears to do nothing but growing.

/ "But...,"/ said Fokker President Swarttouw, /"after all the publicity, after all the attention we have been given, it would be nice if things quieted down for a while. Then we would be able to concentrate on the things that have to be done now, and which will help to determine the future of Fokker."/

8463

CSO: 3102/22

TRANSPORTATION

PLASTIC INTAKE MANIFOLD DEVELOPED FOR MASS PRODUCTION

Helsingborg PLASTFORUM SCANDINAVIA in Swedish No 9, 1981 p 123

[Article: "Intake Manifold of DMC Withstands High Stress"]

[Text] An interesting step toward the development of new plastic parts was taken jointly by three English companies with the production of an intake manifold made completely of fiberglass reinforced polyester. The part, which is produced in a single process from DMC (dough molding compound, glass and polyester in dough form), is a casting of existing manifolds of aluminum used in the Ford Cortina 1.3 L and it has been produced through the cooperation of Ford, Fibreglass, and BTR Permali in England.

As a rule, most plastic parts developed for the automobile industry are parts subjected to low stress. The reinforced polyester manifold marks the introduction of plastic parts under the hood, which are subjected to considerably higher stresses.

The manifold, which distributes the mixture of air and fuel from the carburetor to the cylinders, is subjected to high temperatures when the car is operating and severs vibrations in the engine. This has placed great demands on the choice of the material developed jointly by BTR Permali and Fibreglass.

The fiberglass reinforced polyester, which was the result of this development work, possesses high thermal stability and thermal conductivity, high mechanical strength, and the ability to withstand the stress of warm water and hydrocarbons for long periods of time. The material is well suited for extrusion and possesses fluid properties that minimize fiber breakage and weld lines. Another advantage is that the parts can be produced to machine tolerances, since the compound has minimal shrinkage. The advantage here is that expensive mechanical finishing, which is required with metal components, is eliminated.

Producing the manifold in a single section seemed to be the only way to avoid leakage when the part was in use. Molding methods previously available were limited, in part because the manifold has an extremely complicated cavity. For this reason, BTR Permali, together with Ford, developed a new production process with a view toward possible mass production.

With this method, nitrogen is used to inject molten metal into a mold at a temperature mold of 20°C. The mold contains an insert with exactly the same shape as the desired product.

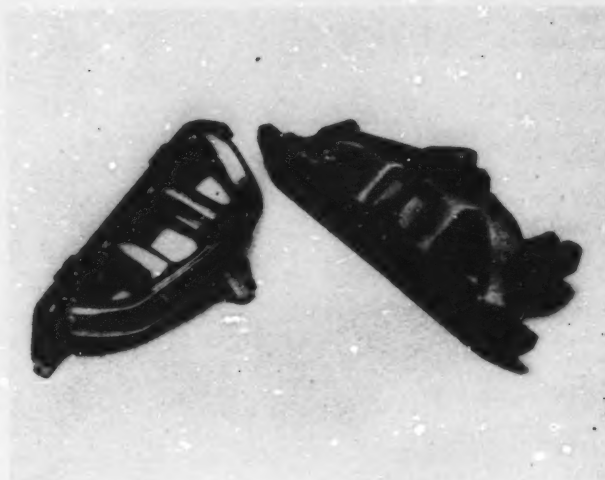
In the next step the nitrogen pressure is reduced and the unsolidified metal is let out. The mold is then opened and the hollow case of metal is finished and can be removed. It is then a negative replica of the desired product.

It is then placed in the mold in the finishing machine after which the mold is closed and DMC injected.

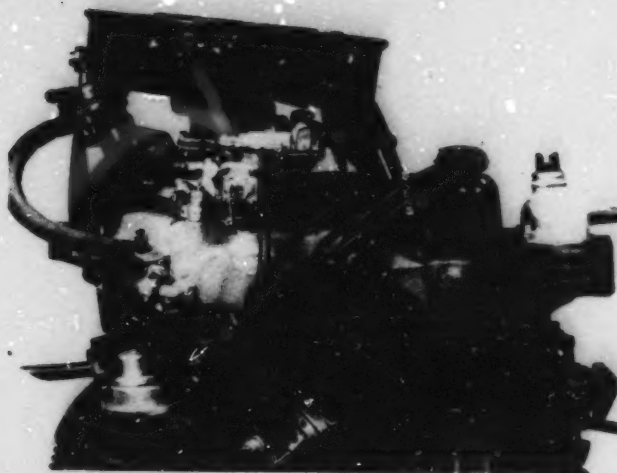
When the part is finished, it is placed in an oil bath at 190°C. At this temperature the metal surrounding the plastic melts and an exact copy has been produced.

The finished part is required to withstand a continuous thermal load of 110°C and, since the limit for heat deformation is 250°, there is a wide margin of safety.

By using a metal in the process that has a much lower melting point than the plastic, even the most complex cavity designs can be reproduced. The metal is a combination of tin and bismuth. It is collected for reuse.



Intake manifolds for the Ford Cortina
1.3 L made of fiberglass and polyster.



Manifold installed on engine.

9336
CSO: 3102/19

TRANSPORTATION

PROTOTYPE OF ELECTRIC CAR TO BE TESTED

Duesseldorf VDI NACHRICHTEN in German 18 Sep 81 p 20

[Article by Hans-Georg Mueller: "Fuel from the Wall Socket"]

[Text] The "Citystromer"--the prototype of an urban electric car--is intended to provide pointers and experience for the wider use of electric vehicles, in order to counter higher fuel prices.

The externally started DC shunt-wound motor, which has a continuous rating of 12 kW, can be overloaded 100 percent for short periods and gives the vehicle the driving characteristics required in town traffic. The electronic regulator is designed to provide regenerative braking. It is supplemented by a standard, manually shifted transmission. The vehicle can be started from rest both by electronic control and through a mechanical clutch. The battery chosen for the specified operating requirements consists of 16 6-volt modules, with a nominal voltage of 96 volts and rated at 134 Amp/hours at a discharge time of 5 hours. With today's state of technology, it could only be a lead accumulator with positive tubular plates. The block of batteries weighs 392 kg, which required the use of strengthened components around the rear axle.

In order to extend service intervals, the battery is equipped with recombinators. A heating element prevents loss of capacity at low temperatures.

A new feature is the location of the batteries in a plastic bin, which was let into the floor of the body at the rear of the vehicle. In this way, the rear seats could be retained, without reducing the required ground clearance.

For normal operation a 2-kW charger was installed in the vehicle, which can be plugged into any ordinary outlet (220V, 16A) with a cable. If all the time that the vehicle is parked is used consistently for interim recharging, daily journeys up to 100 km can be made. An additional plug-in point for recharging from larger, stationary charging units can be built in. It allows even wider ranges of operation, or, when used correctly, shortens recharging time to about 1 to 2 hours.

Measurements with a medium load under city traffic conditions showed an average consumption of 32 kWh/100 km. Converted into different energy terms, this is the equivalent of a gasoline consumption of 3.6 liters/100 km, or a diesel consumption of 3.2 liters/100 km.

About 10 percent of the energy taken from the grid is reused through regenerative braking, thus compensating to a considerable degree for the high energy requirements for acceleration, a result of the additional weight of the batteries.

Although about three times as much primary energy must be used for the generation of "electric fuel," the result is encouraging, if one considers that domestic coal or other primary energy sources that cannot be utilized in other ways, such as uranium, can replace valuable imported oil of almost equal energy content.

It often seems to have been forgotten that coal and other primary energy sources have been "converted" for decades, using large-scale technology, into the most versatile and cleanest form of final energy, electricity. So the next stage is to make use of available technology and employ electric vehicles wherever possible, for example, for short-distance driving.

For the foreseeable future, integrating electric vehicles into the existing consumer group will not require additional investment in generating stations and transmission lines because of their good charging characteristics. With 10 billion kW hours/year--about 3 percent of the electrical output from the grid of the German EVU [electric power companies]--more than 2 million electric vehicles can be supplied, or about 10 percent of the total traffic load on the roads of the FRG can be met. By contrast, in the government's report of 16 February 1981 (Bundestag publication 9/165) the estimate is for an initial potential application of only 5 percent.

The electric car would undoubtedly be an energy-efficient, rational and environmentally benign vehicle. However, it can only become economically competitive when the risk of large-scale production is taken. Before this happens, additional progress in battery technology is needed. In this direction, the test program is intended not only to provide results concerning technology and possible applications, but also to encourage the development of promising laboratory results for production.

9581

CSO: 3102/27

TRANSPORTATION

BRIEFS

FLEXIBLE WORKSHOP--A flexible workshop for the assembly of Jaeger dashboards. Europe's first flexible chain for the automatic assembly of dashboards has just been put into operation by Jaeger in its Caen factory. This plant will allow equally the assembly of several kinds of dashboard for all manufacturers. Today, several kinds of dashboard are assembled for Renault on this chain; the dashboards for the R18, the Fuego, the R20, R30, and the new R9. This flexible workshop was planned on the basis of a daily output of about 3,000 dashboards. The plant is made up of 13 robots, placed along a production line of about 50 meters, tied in with three subsidiary chains which take care of subunit preparation (assembly of dials, calibration of apparatus) and with an automated quality control chain.

[Text] [Paris ELECTRONIQUE ACTUALITES in French 9 Oct 81 p 4] 9824

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West Europe Report

SCIENCE AND TECHNOLOGY

No. 83

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ELECTRONICS

AEG-TELEFUNKEN OPENS CIRCUIT DESIGN CENTER

Paris ELECTRONIQUE ACTUALITIES in French 16 Oct 81 p 14

[Text] Ulm - AEG Telefunken has just made available to outside customers the services of an integrated circuit design center which, until now, had been used only to fill the internal needs of the company and whose importance has considerably increased lately.

The center is original in two ways: it is used to study all types of circuits in all technologies, even those which are not handled by the company's semiconductor plant at Heilbronn. It thus makes use of the properties of P-MOS (aluminum gate), E-MOS (silicon gate), and bipolar circuits (analog, digital, or both in IIL) produced in Heilbronn, as well as C-MOS components from outside vendors. The center offers an unusual range of uncommitted logic arrays including BiFET for low noise applications, transistor networks with a clock time of 5 GHz for A/D conversion, mixers, dividers, etc. and IIL circuits for mixed analog/digital applications.

Uncommitted Logic Arrays BiFET and 5 GHz

Among the uncommitted logic arrays being designed, the most attractive is certainly a C-MOS network integrating switching capabilities especially designed for filter applications.

The AEG-Telefunken operation in the area of uncommitted logic arrays is very similar to that of its best-equipped competitors throughout the world, in particular, the turnaround times required to personalize circuits may be as short as 2 months. The range of circuits offered by the company at the present time is mostly oriented toward linear applications, or linear and digital combinations. Only two uncommitted ISO-CMOS arrays with 540 gates and 1,000 gates respectively are currently offered for purely digital applications (ref. SP 7005, and SP 7010). Other less complex and more complex CMOS circuits will follow (C 600 and C 1920 with, respectively, 600 and 1,920 gates.)

The first two linear uncommitted logic arrays developed by the company, IMCA [expansion unknown] and BIUS [expansion unknown] are conventional bipolar transistor networks with a 500 MHz clock time for the NPN version and 5 MHz for the PNP version.

The IMCA includes 65 NPN and 14 PNP transistors, 193 resistors, and 5 Zener diodes on an 8 mm² chip. The BIUS includes 394 NPN and 170 PNP transistors, 594 resistors, 22 capacitors, and 29 Zener diodes on an 18 mm² chip. The first is well adapted to operational amplifier applications or multivoltage regulators. The second can be used in complex analog applications.

Three other original gate arrays are following: a low-noise model; a UHF module; and, very recently, a module with 2.5 μ m structures for high-frequency applications.

The M80/7023 BiFET Array is intended for low noise applications and includes 112 500 MHz NPN transistors, 47 5 MHz PNP transistors, 14 FETs, 261 resistors, 4 capacitors, and 6 Zener diodes on an 8 mm² chip.

The T 800B UHF array includes 380 5 GHz NPN transistors, 40 5 MHz PNP transistors, 245 resistors, 16 capacitors, 10 Zener diodes, and 12 Schottky diodes. There are 130 output contacts, as compared to 21 to 42 in other modules. This array is well-adapted to A/D converter, UHF mixer, and frequency divider applications.

Finally, the latest transistor array is the BUUS [expansion unknown], a 12 mm² bipolar array using 2.5 μ m structures and including 440 active components (200 of them HF transistors) and 250 passive components. This array is well-suited to HF circuit applications in general, such as preamplifiers, mixers, wideband amplifiers up to 1 GHz, etc.

IIL Uncommitted Arrays with up to 736 Gates

AEG-Telefunken has developed two uncommitted logic arrays for applications requiring a mix of analog and digital circuits, both of them using IIL technology. The first module, BADY 1 [expansion unknown], includes 328 4-output gates, 155 500 MHz NPN transistors, 23 5 MHz PNP transistors, 128 resistors, 2 capacitors, and 58 contacts on a 12 mm² chip. Like the next one, this circuit uses two metallization layers. The second, BADY 2 [expansion unknown], includes 736 gates, 122 500 MHz NPN transistors, 28 5 MHz PNP transistors, 84 resistors, and 68 contacts on a 16 mm² chip. These analog components are arranged around the sides of the chip into 28 cells with 4 NPN and 1 PNP 4-collector transistors each. They can be used for logic input as well as control applications. It is thus possible to create output stages with a gain of 10,000 and capable of delivering up to 20 mA.

The BADY 1 may deliver up to 150 mW, and even 1 Amp, when several cells are connected together.

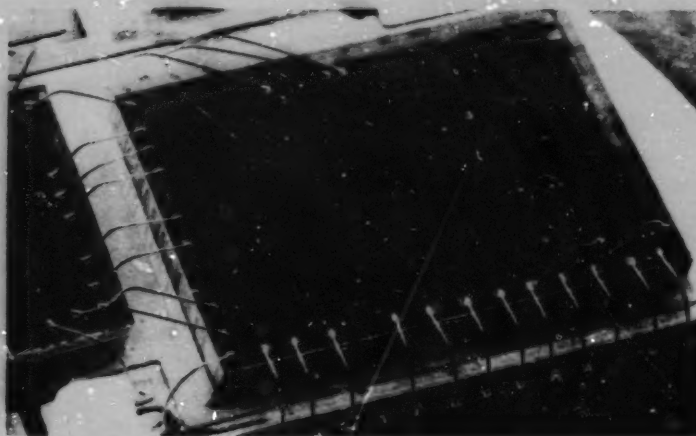
In order for users to be able to build models using the various integrated circuits offered by the company, AEG-Telefunken offers metallized and nonmetallized BIUS circuits to implement simple functions. Sixteen-pin modules with 5 10 mA NPN transistors, 5 100 μ A PNP transistors, 3 50 mA NPN transistors, and 2 500 μ A PNP transistors are available as well as a 7-input PNP power transistor, a 7-input NPN power transistor, and a modulator (4-cycle multiplier). A programmable quadruple operational amplifier circuit is offered as a 28-pin module. As a 32-pin module, this circuit is quintupled.

A series of standard test circuits also has been developed for the IIL BADY II family: one circuit provides I/O accessibility to 5 NPN and 2 PNP transistors, 1 IIL gate, 6 resistors, and 5 ring oscillators (4 with 7 stages and 1 with 75 stages); another circuit incorporates 2 7-bit phase displacement registers, 1 4x4 multiplexor, and even 3 thyristors; finally, a third circuit includes an I/O accessible 239-gate ring oscillator, 3 resistors, a PNP transistor, and 3 current sources. Circuits with prewired functions also are available in the ISO-CMOS family of uncommitted arrays but we now know that is possible, through AD design and simulation, to avoid using models for purely logical circuits.

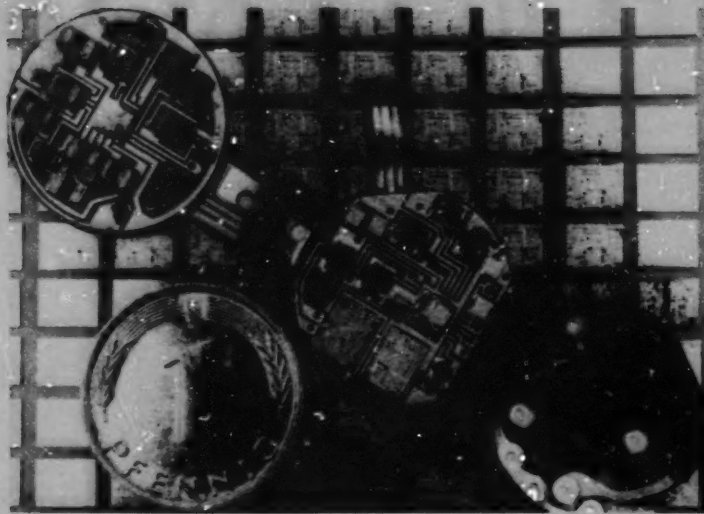
We should point out that, in some cases, AEG-Telefunken makes use in the Ulm plant of their MEBES electronic mask-maker to cut circuits directly on the wafer in order to obtain samples rapidly, without having to cut physical masks. Personalized uncommitted array samples can then be obtained in 2 to 4 weeks. (The company's APPLICON circuit drafting system produces tapes that can be used directly by the mask-maker.)

The wafers are made into uncommitted arrays either at Heilbronn or by outside vendors in Europe or elsewhere.

For the development of uncommitted arrays, the Ulm plant currently has an APPLICON VLSI-860 interactive graphics system with four work stations, a Versatec and Calcomp plotter, a MEBES electronic mask-maker, a Sentry VII automatic tester, and a Hewlett-Packard IEC bus tester, all under the control of a VAX 11/780 computer with 10 terminals.



Set of four custom-made integrated circuits developed at the Ulm design center for a small Doppler effect radar.



The enlarged chip shown is the system's central chip. It uses ILL technology and includes 4,000 transistors for memory, filter, and calculator functions.

6445

CSO: 3102/36

ELECTRONICS

THOMSON-CSF EXHIBITS GALIUM ARSENIDE CIRCUIT

Paris ELECTRONIQUE ACTUALITES in French 30 Oct 81 p 11

[Text] Fujitsu has just developed the first experimental GaAs integrated circuit (IC) using transistors with high mobility electrons (HEMT, also known as TEGFET—see our issue of 25 September 1981), which makes it possible to approach the speed of Josephson junctions at liquid nitrogen temperature (-169°C), instead of the latter's operating temperature of -269°C (17.1 ps propagation delay, compared to 13 ps). This circuit was presented at the Third GaAs IC Conference, held in San Diego (USA) on 27-29 October, where Thomson-CSF described an experimental eight-bit, fully decoded static RAM, also made of GaAs, which uses the LPPL technology (see our issue of 5 December 1980) developed by the LCR [expansion unknown], and which has an access time of 0.6 ns and consumes 80 mW.

The devices presented by both companies are only the first in the field of rapid logic GaAs IC's. By using finer geometries, Fujitsu hopes to obtain—still at liquid nitrogen temperature—propagation times of 10 ps for 10 uW consumptions. This should open the way for very rapid VLSI circuits which could eventually replace Josephson components. For its part, the LCR is developing a 256-bit RAM with an access time of 1.5 ns, in order to obtain by the end of 1983 a 1K device accessible in less than 2 ns. The technologies used by the French and the Japanese may seem to compete against each other. Indeed, with a technology similar to the one used by the LCR (called quasi normally-off because the transistors are nearly off at rest), NTT has obtained GaAs FET'S with switching times of 30 ps at ambient temperature, and 17.5 ps at 77°K . The drawback of this technology however, is the consumption and the difficult fabrication (it requires 0.5 micron grids).

17.1 ps And 0.96 mW Per Stage at 77 °K

Using HEMT transistors with 1.7 micron-long grids, Fujitsu has built a 27-stage ring oscillator with propagation times of 17.1 ps/stage, and with a consumption of 0.96 mW at 1V and 77 °K (giving a figure of merit of only 16.4 fJ). With grid lengths of 1 micron, Fujitsu hopes to obtain three times the mobility at liquid nitrogen temperature ($60,000 \text{ cm}^2/\text{V}$), which should make it possible to reach propagation delays of 10 ps and consumptions lower than 100 uW. The circuit of the Japanese company was built on a semi-insulating GaAs substrate by molecular jet epitaxy. The Thomson CSF LCR also uses vapor phase epitaxy. The eight-bit (4xtwo-bits) memory presented in San Diego integrates 170 components, of which 77 are quasi normally-off MESFET's with 0.8 micron grids and threshold voltages between -0.2 V and 0.2 V. It operates at 4.6 V. Each memory cell includes two transistors, four resistors, and two Schottky diodes, and covers an area of 5900 micron^2 (0.5 mm^2 for the entire memory). The consumption is 1.6 mW per memory point, and the LCR hopes to obtain 0.45 mW for the 1K RAM by using a finer geometry.

11,023

CDO: 3102/44

ELECTRONICS

NETHERLANDS RESEARCH CENTER FOR SUBMICRON CHIP TECHNOLOGY

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 13 Oct 81
p 5

[Text] The Advanced Technical School in Delft, Holland, will establish a national center for submicron technology (submicron = smaller than a thousandth of a millimeter). The minister of science policy in The Hague, van Trier, indicated shortly before the change in the cabinet in the Netherlands some weeks ago that he is prepared to make available to the institute financial means in an as yet undisclosed amount. As the minister wrote the administration of the Delft Advanced Technical School, other institutes, including N. V. Philips, are also interested in the establishment of a submicron center in Delft, and it would be possible to expect financial support from them, too.

According to one of the initiators of the center, Prof Dr B. le Poole, lecturer in electron optics in the Department of Technical Natural Science at the Delft Advanced Technical School, the intention was to establish a center like the American National Submicron Facility at Cornell University. The center will be concerned not only with the use of superchips and with semiconductor technology. It will make possible research from all angles which could play a role in the production of submicron structures, also for researchers from other universities or from industry. Everything that is needed to produce submicron structures and everything that is necessary for experiments on a submicron scale will be provided. In general, the center will serve to collect experiences and findings in the field of submicron technology. The center will also have to be involved with the problems of industry, and perform research tasks for them if necessary. Professor le Poole said in closing that, although people in Leuven (Belgium) and Aachen are also working in the field of submicron technology, the center in Delft will be unique in Europe because it will be concerned with more than the application of technology.

12124

CSO: 3102/24

ELECTRONICS

SIEMENS COMMERCIALIZES HIGH-SPEED 64K DYNAMIC RAM

Paris ELECTRONIQUE ACTUALITES in French 23 Oct 81 p 15

[Article by F. Grosvalet]

[Text] Siemens is commercializing a memory with a 150 ns access time and a power consumption of 120 mW.

Siemens has begun to spot-market in France its 64K dynamic RAM (DRAM), the HYB 4164, which it announced more than two years ago. Volume production should start before the end of the year in a new plant that the company has built in Austria at Villach (as well as in Munich); it will reach 100,000 units per month in 1982. Siemens thus becomes the first European company to manufacture a 64K DRAM; the British company Immos had also announced such a device last April, but its product has still not been introduced.

The price of the HYB 4164 has not yet been established, but all other things being equal, the slowest version should be sold for less than \$10 in large quantities, starting early next year, which would place it squarely in the middle of the price range (the average price of 64K DRAM's should reach \$3 in 1986).

Late Arrival

Even though other manufacturers give Siemens few chances of success, a large market study company, Gnostic, believes that despite its late arrival, the German company will play an important role because it has a good technology (notably for protection against alpha particles) and a good product, equivalent to that of the Japanese. However, Gnostic expresses some reservations about Siemens' ability to follow through in production.

150 ns Access Time

As all 64K DRAM's, the HYB 4164 is organized in 64K one-bit words and operates at 5V; but it has a 150 ns access time and typically consumes only 120 mW (150 mW maximum) during operation, and 12-15 mW at rest (20 mW maximum). A less rapid version is also available with an access time of 200 ns, and a typical consumption of only 100 mW during operation (150 mW maximum).

The fact that this memory has an access time of only 150 ns is very important for the success of its market introduction, since memories with this specification, which are in the greatest demand, are still quite rare.

Siemens has succeeded in reducing the access time and consumption of its memory by using half as many read amplifiers and a 256 cycle refresher. Except for these characteristics, the HYB 4164 is rather conventional, both in structure and operation. It is built as a silicon grid NMOS, with an area of 29.5 square millimeters, and uses no redundancy. It is offered in a 16-lead ceramic DIP package.

Another original aspect of this memory is the manner in which it is protected against alpha radiation. To this end, the German company uses a photoreactive organic polyamide film which is very easy to apply (it requires fewer processing steps than conventional films).

2.1 Billion Dollars in 1986

With the HYB 4164, Siemens is entering a market which promises to be the most profitable in the history of semiconductors (it should top at \$2.1 billion in 1986), just at the time when it is beginning to take off. According to Dataquest for instance, eight million 64K DRAM's have been sold in 1981, compared to 400,000 in 1980 (11 million according to ICE).

Siemens, who believes that in 1985 only 5-10 manufacturers will be capable of supplying the 64K DRAM market (estimated at 650 million units by Dataquest), hopes to be one of them and to eventually capture 5 percent of the world market. Today, this market is dominated by the Japanese (according to ICE and Dataquest, they control 70 percent of it): out of eight mass production manufacturers, six are Japanese (led by Hitachi and Fujitsu, followed by Mitsubishi, OKI, Toshiba, and NEC), and two are American (Motorola, closely followed by Texas Instruments). This situation could very well change in 1982 with the arrival of Siemens, Intel, National Semiconductors, Immos, and Fairchild, and the introduction of more rapid models (which are in the greatest demand). Currently, few manufacturers are able to supply models with access times lower than or equal to 150 ns, and some, like Intel and Motorola, have been forced to either redesign their circuits, or develop a second generation.

Most of the American manufacturers feel that they still have time to react, and that the arrival of new American companies on this market will gnaw away at the Japanese domination. According to Texas Instruments for instance, the United States should have 60 percent of the world market in 1984.

In Europe, ITT should be the next to attempt a 64K DRAM, since Eurotechnique's device as second source to National Semiconductors is forecast only for the end of 1982.

11,023
CSO: 3102/43

ELECTRONICS

BRIEFS

MICROELECTRONICS CONFERENCE--The French Vacuum Society has scheduled a Workshop on Plasma Etch in Microelectronics, to be held on 24, 25, and 26 November, in Grenoble, at the Centre d'Etudes Nucleaires. This workshop, at which will be presented the various studies being conducted in France in reactive plasma, reactive ion plasma, and reactive ion beam plasma, is sponsored by DGRST (General Delegation for Scientific and Technical Research), DAI (International Industrial Affairs Directorate), DIEI (Bureau of Electronics and Data Processing Industries), and by the Ministry of Industry. New ion etch equipment manufactured by ALCATEL in collaboration with LETI-CENG will be shown at the end of the workshop. For information: SFV, 19 rue du Renard, 75004 Paris, Tel. (1) 278.15.82. [Text] [Paris ELECTRONIQUE ACTUALITES in French 23 Oct 81 p 13] 11,023

PLASMA ETCH--A new company which will manufacture plasma etch equipment, Plasma Technology, has just been formed. This British company sells a planar plasma etch system, the PE 80. The PE 80 is a compact, inexpensive system, designed for small productions and for research and development laboratories, which will be in a position to evaluate the advantages of this type of plasma etching. [Text] [Paris ELECTRONIQUE ACTUALITES in French 23 Oct 81 p 13] 11,023

CSO: 3102/44

ENERGY

METHOD DEVELOPED TO INCREASE EFFICIENCY OF SOLAR CELLS

Essen ELEKTRO-ANZEIGER in German No 17, 1981 p 10

[Text] At the Karlsruhe Nuclear Research Center (KfK), an electron beam generator has been developed for the short-time heat treatment of the surface of solar cells. This so-called short-time annealing is of great importance for the cells' efficiency in converting sunlight into electrical energy. In addition, the new electron beam generator promises particularly economical completion of this basic step in the mass production of solar cells.

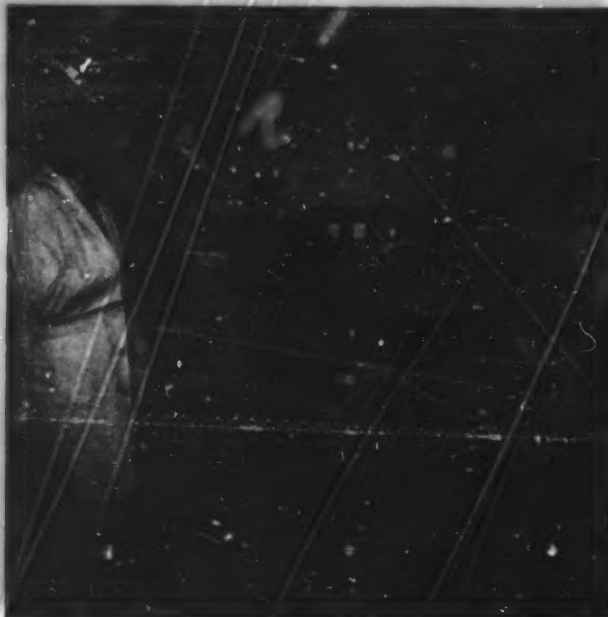
Solar cells, which are spoken of today as mass-produced articles, usually consist of single crystals of the semiconductor silicon, in which foreign atoms are embedded in very low and precisely controlled concentrations. Light falling on them releases in the silicon negatively charged electrons and positive charges, so-called "holes," which are separated by the electrical action of the embedded foreign atoms and create a usable electrical current. A familiar application of this principle is the light meter in a camera.

For reasons of physics, these semiconductor elements have a maximum efficiency; that is, the ratio of usable electrical energy to the light energy falling on them is about 20 percent. In practice, the degrees of efficiency achieved today are about 10 percent, and they are largely dependent on the purity—that is, the unblemished formation—of the crystal lattice on the light-sensitive surface layer. A requirement for good purity is thermal treatment—annealing—of the surface, which cures the faults in the crystal caused by the implantation of the foreign atoms, but which does not cause a redistribution of the foreign atoms by diffusion. For reasons of physics, only short-time annealing can be used. A process of this kind is also a requirement for the inexpensive mass production of solar cells, since it makes continuous treatment of large areas possible with low energy use. Extremely short-time electron beam impulses of a particular energy density and with relatively large spatial expansion, which penetrate only a short way into the semi-conductor layers, can do this, but until now it has not been possible to produce them.

An electron beam generator with the required characteristics was developed for this purpose at the KfK's Institute for Applied Nuclear Physics (IAK). The electron beam has variable energy from 10 to 25 keV, which is the equivalent of the required penetration depth of up to 10^{-3} mm; pulse duration is about 0.3 μ sec, current densities in the beam are 1,000 to 3,000 A/cm² and the pulse energy deposited in the

material is adjustable between 0.3 and 2.5 J/cm². The diameter of the electron beam is about 5 cm at the point of irradiation. In the field of electron beam technology these operational data are unique so far.

Development work at the IAK lasted for about 2 years and cost about DM 80,000. Laboratory testing of the equipment has been successfully completed. It is currently being used by interested parties for the test manufacture of solar cells. Further development is aimed at industrial application.



The laboratory equipment for the short-time annealing of solar cells on a silicon base consists of an electron beam generator, upper center, the vacuum chamber for the irradiation of the silicon slices, center, and the vacuum apparatus in the lower part of the picture. On the left the essential electronic controls can be seen. The picture shows the silicon slices being inserted for short-time annealing. (Picture courtesy of the Center for Nuclear Research, Karlsruhe)

9581

CSO: 3102/29

ENERGY

BRIEFS

FRG-SPAIN SOLAR PROJECT—An agreement has just been signed in Madrid between the FRG and Spain for joint research into the conversion of solar energy into electricity using gas-cooled "solar towers." The project, named "Guest," calls for investments in the amount of about DM 88.4 million in the Almería Solar Energy Research Center (southern Spain) and later the construction of a 20-MW solar power station in the western Spanish province of Badajoz. [Text] [Wuerzburg ELEKTROTECHNIK in German 11 Sep 81 p 7] 9581

NEW WIND ENERGY CONVERTER—Voith Getriebe KG [limited partnership] of Heidenheim recently began test operations with the wind energy converter which it developed and whose erection has just been completed near Stoetten in the Swabian Alb. The 300-kW generator is located at the foot of the 30-meter high mast, which carries at its top the pod with the two 26-meter-long rotor blades, the transmission and the control machinery. A tubular shaft connects the pod with the generator. At medium wind speeds of 8.5 m/sec, rotor output is designed to be 316 kW. The 380 V direct current is fed into the 20-kV cross-country grid through a transformer. The project has been subsidized since 1976 by the FRG Ministry for Research and Technology. [Text] [Wuerzburg ELEKTROTECHNIK in German 11 Sep 81 p 7] 9581

COAL LIQUEFACTION PLANT—Geisenberg AG, a subsidiary of Deutsche BP AG and Saarbergwerke AG have announced a joint project to build a coal liquefaction plant with a capacity of producing 1 million tons of gasoline in the Saar region. With an anticipated cost of 3 billion DM, the plant will only be built (starting in 1984) if the results obtained at a pilot installation turn out to be satisfactory. The process will be a modernized version of the process developed by IG Farben during World War II. The new plant could be operational between 1988 and 1990 and would be capable of processing 2.3 million tons of coal per year. The coal would be produced by Saarbergwerke Company. [Text] [Paris CHIMIE ACTUALITES in French 25 Sep 81 p 10] 6445

CSO: 3102/36

INDUSTRIAL TECHNOLOGY

STUDY SHOWS FLEXIBLE WORKSHOPS NOT ECONOMICAL IN FRG

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 15 Oct 81 p 7

[Text] Frankfurt, 14 Oct--As a response to the growing demand for automation in small and medium production runs in the metal processing industry, [word omitted in text] were developed, beginning in the mid-1960s, in which individual numerically controlled machine tools were linked by material flow and information systems. According to initial prognoses, these systems were supposed to spread rapidly in the FRG. Because of the associated high degree of automation and large capital investment (the acquisition costs for a system are mostly between DM 3 and 20 million), substantial effects on the competitiveness, company structure and the organization of work in the metal processing industry were anticipated.

As the Fraunhofer Institute for Systems Technology and Innovation Research in Karlsruhe has just shown in a study, these ambitious expectations regarding the spread of flexible manufacturing systems have not been fulfilled. There are only 10 to 15 such systems in the FRG in 1981. The numbers of systems in use in Japan and the United States are much higher, although the flexibility of the systems installed there is clearly lower than in the FRG (in the United States, most flexible manufacturing systems are designed to handle 5 to 10 different pieces, in Japan 10 to 100, but in the FRG from 100 to 200).

In all the Western industrial countries, flexible manufacturing systems have been installed predominantly in large plants, mainly in the machine, construction vehicle construction and aerospace industries. Besides the high purchase price, the reason can be found in the considerable expenditure of time and money required for the planning and introduction of these systems: According to the findings of the Fraunhofer Institute, equivalent costs in the FRG average DM 1.9 million, and the time required is between 3 and 6 years. These figures are considerably lower in Japan and the United States. It is predicted that the costs of planning and introduction will also fall in the FRG: For newer systems, the expenditure for introduction has already dropped to an average of DM 1 million.

The hesitant introduction of flexible manufacturing systems in the FRG is determined principally by the high purchase costs. The flexible systems used here are also not yet economical in most cases. This is not true for the American systems, which are less advanced but operate more economically. It is expected that the growing demands for automation and flexibility will boost the use of flexible manufacturing systems in the FRG as well. Increasingly, the path of gradual development will be followed with respect to automation, flexibility and system size. At the same time, both

acquisition costs for the various system components and the cost of planning and introduction must be reduced. It is also necessary for manufacturers to commit themselves more heavily to the introduction of flexible manufacturing systems (in the area of design and consultation). The state should support the manufacturers in this offer of services and, in the opinion of the institute, subsidize introduction principally in smaller and medium-size companies.

9581

CSO: 3102/31

SCIENCE POLICY

GOVERNMENT INCREASES AID, INCENTIVES TO INNOVATION

Paris L'USINE NOUVELLE in French 22 Oct 81 p 85

[Article by Marc Chabreuil: "Innovation: Releasing the Last Brakes"]

[Text] "To gain 10,000 research enterprises over the next 5 years," is the ambitious goal which Anvar [National Agency for the Valorisation of Research] has established for itself. Following the national meeting which the agency organized in Lyon, this challenge seems possible to meet. For, its field of activity is going to expand and diversify itself. Furthermore, the agency benefits from the strong support of the minister who oversees it, Jean-Pierre Chevenement, and of the prime minister, both of whom came to back this event.

In addition to the good report he issued to Christian Marbach, president of the agency, Pierre Mauroy used this occasion to try to win over the 800 heads of enterprises who were present. And, through them, the small and medium-size industries on the whole. For there are many who are showing their gloom and admitting that their innovative projects are shelved for the present.

At the Heart of the Discussions: Financial Matters

After having assured them that "the enterprise will remain an autonomous center of decision," the prime minister attacked the current banking system. According to him, "it is poorly adapted to the needs of enterprises and grants too large a place to supplier credits and short term lending." A problem which closely affects manufacturers, accustomed to the hesitation of bankers when long term projects or establishment of businesses are involved.

Financial questions, for that matter, were at the heart of this national meeting. And Jean-Pierre Chevenement made more statements on this subject, announcing measures which will come in both up and down the line from innovation, in Anvar's sense of the term (research and development of a prototype).

It is thus that, starting in 1982, the agency will implement mechanisms to take on part of the purchase price of new products in order to lower their prices and encourage their sales. Similarly, it will participate in "intangible" investments (research and development, purchasing of patents and licenses, market studies).

These are important decisions for small and medium-sized industries, but do not include a measure for financially assisting the industrialization of an innovation,

a measure clamored for by the small enterprises who often do not have the appropriate capital required.

Through Inodev [expansion unknown] they will finally have access to medium term loans, as the government has decided to activate this organization by increasing the number and the size of the loans available and reducing the interest rates. To do this, it is counting on joining with other partners (Anvar, banks,...). Simultaneously, negotiations are in progress between Jean-Pierre Chevenement and Jacques Delors to adapt the banking system to this phase of innovation.

Also at the request of Anvar, which is Jean-Pierre Chevenement's main "bridge" to the industrial sector, three new companies for financing innovations are going to be created: Finovelec (rational use of energy, electricity and electronics), Electrinova (some areas, but basically for small and medium-sized industries) and Idianova (aquicultural and food/agricultural products). "Recourse to such companies for moderate raising of capital or contribution of appropriate funds in the form of convertible loans will spare the manufacturers the risks associated with the embroilment of a new partner in their capital," affirms Jean-Pierre Chevenement who, in this case, is counting on the participation of nationalized companies.

These companies, moreover, will be more and more involved with innovation, whether by doing contract research for the small and medium-size industries, or by assisting their personnel to create high technology companies. Christian Marbach, who already has limited contracts with Elf and Renault mentions "the creation of joint teams with these industrial groups and the placing of an Anvar representative within each of them."

Other projects are under study or in discussion with the ministers involved: increasing the rate and the conditions for allocation of premiums for innovation, partial assumption by the agency of the documentation for establishing companies, broader support for industrial research through assuming some of the personnel expenses (on the condition that actual results be obtained in less than 2 years), making assistance to innovation more widespread in technical colleges to make students and professors, in particular, more open to creativity.

All additional expenses with a strong risk of causing the budget to be exceeded. Now, Jacques Delors and Laurent Fabius, already hostile to the large increase in funding granted to research, refuse in principle to accept any idea of a collective. "We have planned for next year the maximum of what we can do in research and development," states Pierre Mauroy, who seems to be delaying any possible measures on fiscal incentives to innovation for at least 2 years.

Without going so far into the future, can the government, and through it Anvar, finance all the measures announced...in the future or conditionally?

9693

CSO: 3102/39

SCIENCE POLICY

BRIEFS

INDUSTRIAL DEVELOPMENT COUNCIL--A Higher Council for Industrial Development will be formed next year, according to the announcement made by Prime Minister Pierre Mauroy during his presentation of the nationalization law to the Chamber of Deputies. This council, he said, will "gather together all concerned parties," and will have the objective of "creating a consensus on the goals and means of our industrial development." He went on to add that it will "participate in a fresh new growth, encourage the creation of jobs, particularly in small enterprises, develop exports, and recover a domestic market,...as well as assure for France the mastery of technologies that are most decisive for the future." [Text] [Paris ELECTRONIQUE ACTUALITES in French 23 Oct 81 p 2] 11,023

CSO: 3102/43

TRANSPORTATION

ANALYSIS OF COMPETITION BETWEEN AIRBUS INDUSTRIE, BOEING

Paris SCIENCES & Avenir in French Oct 81 pp 98,99,101,102,104

[Article by Jacques Morisset: "The 767 Against Airbus: Boeing's Response"]

[Text] What the American builder is offering is not simply an anti-Airbus plane but a complete line of planes ranging from 190- to 300-passenger versions, to prevent the European plane from capturing one-third of the world market by the year 2000.

As these lines are being written, the prototype of the B 767 is being prepared for its first flight over the Everett airdrome near Seattle. The new, red-white-and-blue-colored plane was rolled out of its hangar on 4 August, 3 and 1/2 years after the launching of the B 767 program--a major event at Boeing, who had not produced a single new plane since 1968, the year in which this same Everett plant rolled out the first B 747, the "Jumbo Jet" as it is universally known now.

In 11 years, however, the physiognomy of air transportation has changed radically. The incredible rise in the cost of fuel has been and continues being the number one factor in this change; the golden age of air transportation (+10 percent yearly) dates back to the time when the price of the well-known barrel was just a few dollars, barely higher than the cost of its extraction, transport and refining. It has now reached \$36, the difference being for the most part being siphoned off by the black gold producer countries; and the experts are unhesitatingly forecasting that by the middle of the coming year the producers' selling price will exceed \$50 a barrel.

Twelve years ago, the cost of fuel was thus considered relatively negligible; today, it represents 20-30 percent percent of the per-hour cost of flying. And, it would seem, the worst is probably still ahead of us...

The consequences are known: The Concorde, too great a fuel guzzler, is moribund, without having effected the market penetration its promoters had hoped for. The first-generation jet planes are now doomed: Their engines consume too much fuel. And the airlines, despite a precarious financial situation, are now demanding planes powered by ultra-economic engines.

The all-purpose plane, usable for flights whose range might vary by a ratio of as much as 1 to 10, hence not highly optimized, has given way to planes "fine-tuned" to a specific purpose and lightened to the maximum, offering a 30- to 40-percent reduction in passenger-kilometer consumption. Of course, the modern turbofan is the principal artisan of this reduction in fuel consumption, with the advances made in aerodynamics and new materials accounting for the rest. But the fact remains no less true that a long-range plane designed to carry a heavy fuel load is needlessly heavy for short- and medium-range flights, under which conditions its efficiency is mediocre and a plane optimized for this type of service appears indispensable.

True, the engineers had long since seen the need for this specificity: Dassault's Mercure (which appeared too early and was poorly backed, thus explaining its failure) in fact heralded this evolution. But the airlines balked at abandoning their planes, which in many cases were not yet amortized: A change of equipment (and of supplier) is in fact costly and is financially dangerous if the equipment in question has not been completely tested and perfected before being put into service.

Boeing, as the leading supplier, could hardly do other than perpetuate a situation from which it itself was reaping the greatest advantage. Its B 747 (long-range), B 727 (medium- and short-range) and B 737 (short-range) planes were continuing to sell and to generate all the more profits since their design and tooling costs had been largely amortized or no longer on the books.

The 300-Passenger Niche

In this relatively full gamut, however, there is a fault, and a major one: The B 737 is a 100- to 120-passenger twin-jet; the B 727 is a 130- to 160-passenger 3-jet plane; and the B 747 is a 4-jet plane that can accommodate up to 500 passengers. What was lacking, therefore, was a 300-passenger plane. Lockheed, however, with its 3-jet L-1011 Tri-Star, and Douglas with its DC-10, also a 3-jet plane, largely occupied this niche.

It was then that the Europeans, led by France, decided finally to take up the gauntlet, and created the Airbus Industrie consortium, the main objective of which was to create a twin-jet 250/300-passenger short- and medium-range plane, baptized the A 300. The proposed plane was to:

- offer a lower passenger-kilometer operating cost than that of the 3-jet DC-10 and Tri-Star, simply because it would be markedly lighter and a twin-jet, and optimized for flights of from 500 to 2,500 kilometers.

- make available to airlines that were already using B 727's a dual-capacity plane, without their having to resort to buying planes as heavy and costly as the Tri-Star and the DC-10, or, a fortiori, the B 747.

The A 300 quickly proved to be an excellent plane; but success was a long time in coming, as airlines other than those of the promoting countries saw no reason

to take a chance on changing suppliers: Actually, a transport plane is bought for 15 or 20 years to come; and, aside from the fact of its French and German backing, there was nothing to prove that 15 or 20 years down the road Airbus Industrie would still be an active supplier, capable, for example, of providing a high-quality post-sale grade of service, and of developing improved versions, taking advantage of the technological advances made with time.

It took OPEC and the second wave of oil price rises to bring the potential users--impressed though they were by the good results obtained with the first Airbuses put into service--to the point of finally deciding to "take the risk." What followed was a veritable tidal wave of orders; and Boeing (who found it hard to believe), Lockheed and Douglas suddenly found themselves confronted by an unexpected situation: The advent of a serious competitor, occupying a niche they had mistakenly considered too narrow. True, the DC-10-10 and the L-1011-1 and -100 "medium-range" versions were already in existence; but the decision taken by the Eastern Airlines company (headed by former astronaut Frank Borman) to buy several dozen A 300's exploded like a bombshell, and the European Airbus became a serious competitor.

It took the announcement of a new improved and slightly shortened version, however--the A 310--for Boeing, perceiving at last that the situation had become serious, to decide to enter the arena again. After months of talks with the major American airlines, and just a few days after disclosure of the first orders for the European A 310's, it announced the coming of the B 767. It was certainly not by mere chance that these two disclosures occurred at the same time; and, for the first time in a long time, Boeing found itself compelled to attack defensively.

Things might well have remained as they were; after all, the B 727 still had some halcyon days to look forward to, and so did the B 737; only Douglas had made an effort to recapture the market with an improved version of its DC-9 (the Caravelle's killer), the DC-9 Super 80. But Boeing had established such a lead in terms of number of planes sold and of client airlines (around 250, versus 150 for Douglas), who were still inclined toward completing their fleet with planes of the same kind, that the Super 80 represented no great danger, all things considered. And the speedy, but costly, launching of the B 767 (200 seats, like the A 310), seemed likely to keep Boeing sufficiently occupied.

Occupying the Terrain

But this was tantamount to underestimating the Seattle builder, whose eyes were now opened; the more so, in that the Europeans appeared to be taking the bit in their teeth: Fokker, which was laboring to sell its F-28 (80 seats) seemed determined to promote an F-29 (100/110 seats); AEROSPATIALE [National Industrial Aerospace Company] was pressing its Airbus Industrie partners for agreement on the (AS 200) project for a 130- to 160-passenger plane as a potential competitor of both the B 737 and the B 727. And Airbus Industrie was from time to time leaking information on two new projects: the TA 9 (a lengthened A 300, capable of carrying more than 300 passengers) and the TA 11, a 200-passenger, 4-jet, long- and very-long-range airliner; in short, by adding to its weight but carrying more fuel,

the basic A 300 was shown to be capable of exceeding a range of 5,000 kilometers. A long-term strategy began to take shape in Europe, therefore, aimed at offering a more and more extensive line of products. And for Boeing, the danger loomed larger of its having to fight on all fronts against a competitor that was all the more aggressive because of the tentative backing being provided to Airbus Industrie by the German, British and French governments, while Boeing, or at least its "civilian" subsidiary (Boeing Commercial Airplane Company), has no governmental support and can only count on its own resources, its clientele and the banks.

The tactic adopted by it in response to this threat is a simple one: Occupy the terrain both as regards the airlines and the aviation industrialists not associated with Airbus Industrie. And over the past 3 years, Boeing's response has been one of sheer power, wherein, flanking the B 767, the anti-Airbus par excellence, it has launched successively:

--The B 757: A 160/180-passenger twin-jet, something of a cross between the B 727 (diameter of the fuselage) and the B 767 (technology of the control surfaces, the electronic and hydraulic systems). The first B 757 will fly within a few months and will be put into service by the beginning of 1983;

--The B 737-300: A lengthened B 737 (it will accommodate 140 seats), modernized and powered by new engines: the General Electric/SNECMA [National Corporation for Aircraft Engine Design and Construction] CFM 56. It will be available by the end of 1984;

--Tentative plans (but with a good chance of being actualized) for a B 727-200RE (for "re-engined"). This would not be a new model or a new version, but a modernization of existing B 727-200's, modifying the entire rear end: The three (old-type) existing engines will be replaced by two modern engines, the horizontal tail unit will be enlarged, and the equipment will be upgraded to state of the art, particularly insofar as concerns the cockpit. Cost of the operation: Less than half that of a new plane. Advantages for the client: A less noisy and substantially more economical plane to operate, since it will consume around 25 percent less fuel. The number of planes that can be thus re-engined and modernized: Around 800, out of the approximately 1,800 B 727's of all types sold to date. Many American airlines are showing a great deal of interest in the B 727-200RE;

--Tentative plans also for a B 7-7 (B 787?), a 150-seat twin-jet--a relatively new plane in this case.

This clever tactic, consisting of a well spaced out series of roll-outs over a number of years, gives Boeing the advantage of occupying the terrain and dissuading its customary clients from looking around for other possibilities; but it poses problems of scale: The B 727-200RE threatens to slow the sales of its B 737, those of its B 757 (this plane being situated at exactly a halfway point in its timetable), and those of its future B 7-7. Moreover, in terms of work volume, the conversion of the B 727 to the B 727 RE is much less interesting than the building of new planes; in fact, those most interested in it are the engine manufacturers....

However, although Boeing is thus attacking on all fronts, having furthermore announced long-range versions of the B 767, and improved versions (lengthened upper deck) of the B 747, it finds itself somewhat constrained as to modernizing the lower end of its line, for in all cases Boeing wants to maintain the same diameter of fuselage--in fact, that of the old B 707.

Boeing in a Defensive Position

Boeing's competitors, on the other hand, entirely free to choose, as they are, feel no constraints on highlighting the merits of the wider body and the greater passenger comfort it offers. Since the beginning of this year, plans have been announced for three 150 (actually, 130-180)-passenger, short- and medium-range planes:

--Airbus Industrie's A 320 (ex-AS 200). At the Bourget Exposition, the European consortium announced its decision to proceed; Air France, for its part, disclosed its intention to purchase some 50 of these planes. Scheduled for delivery by 1986, the A 320 will be available in two versions: The A 320-100, which can carry 154 passengers in single-class accommodations over a distance of 3,500 km, and the A 320-200, which can carry 172 passengers over the same distance. By comparison with the B727-200, which is considered the pacemaker plane to be replaced, the A 320 will offer a 20-25 percent lower operating cost, thanks to a 40-percent lower fuel consumption rate. From the standpoint of comfort, its internal width will be greater by 15 centimeters: Passengers will therefore feel less constrained;

--The B 7-7, less new than the A 320, since it is more or less derived from the B 757, but, because of this, less costly to develop and offering a commonality with the latter that can be of interest to users. Its disadvantage: The diameter of the fuselage remains unchanged. In any case, Boeing, financially constrained, as we have pointed out, by the already-launched B 737-300 and B 757 programs, does not expect to have its B 7-7 on the market before 1987 or 1988. The Seattle builder thus finds itself well and truly, for the first time, in a defensive position and compelled, in a manner to which it is unaccustomed, to follow the lead of the Europeans;

--The MDF-100, fruit of a joint study (currently under way) between Fokker and McDonnell Douglas. The former brings to the joint effort the F-29 project (completely revised); the latter, its own studies on a DC-11 undertaken--Oh, irony!--with Dassault, based on the Mercure (a Franco-American project, later abandoned, to bring out a Super Mercure). But the characteristics of the MDF-100, still in the evolutive stage, have not yet been laid down; nor has the date of its launching. In fact, Fokker favors a narrow fuselage, and Douglas a very wide one. The airlines, having been consulted, will settle for something in between.

Three major factors now condition the effective launching of these programs: The coming off the production line of the announced new ultra-economical engines, the availability of funds, and based on the latter, the possibilities of cooperation. On the first point, three engine builders have thrown their hats into the ring

for the needed 11- to 12-ton thrust engine: General Electric and SNECMA with a CFM 56-2000; Pratt and Whitney with a possible PW 2025; Rolls-Royce and its Japanese associates with the future RJ-500. But to develop a new engine costs some \$2 billion (around Fr 12 billion). This consideration alone explains the fact that, according to the latest information, Pratt and Whitney and Rolls-Royce are contemplating a cooperative effort. This would leave no more than two engines from which to choose; that is enough, say the experts.

On the second point (here again, the cost of developing a new plane is around \$2 billion), Airbus Industrie appears to have the advantage, provided, however, that the three governments play their part in the game and that the builders, for their part, can come up with a minimum of financing of their own. Boeing will not be able to find the necessary financing unless the marketing of the B 767, the B 757, and the B 737-300 brings in substantial profits. This is evidently not a likely prospect within the present context, the controller strike in the United States having precipitated a deterioration of operating conditions for the airlines and led some of them to bite the dust. Even Pan Am is in difficulties, compelling it to sell its hotel assets. Hence, no more orders, for the moment.

On the third point, Boeing has, during the past several years, pursued a shrewd policy aimed at attracting the technical and financial collaboration of certain non-American industrialists, so as to not only enable it to reduce its own investments but also to pull the rug out from under Airbus Industrie just in case the latter might be tempted by the worldwide opportunity that would otherwise exist. This operation has fully succeeded with Italian industry, has all but succeeded with British industry (however, the United Kingdom has finally toppled, at least partially, into the lap of Airbus Industrie), and is proceeding toward success with Japanese industry. True, the Japanese industrialists are currently holding talks with McDonnell Douglas and Fokker as well, but on a level that has remained purely hypothetical.

This type of cooperation, however, remains limited: Boeing has retained full leadership, its industrial associates being fully satisfied with being assured of long and even very long production runs (we may some day see the roll-out of the 2000th B 727...). Airbus Industrie, on the contrary, is developing a much more integrated type of cooperation among the three leading countries—France, Germany and Great Britain—without overlooking Spain, the Netherlands and Belgium. Decisions take longer, but they are vested with a spirit of cooperation among equals that is in strong contrast with the sovereignty exercised by Boeing.

Although the future of the 150-passenger plane is assured, though still somewhat hazy (Will there actually be three programs, or more probably two?), the current struggle has thus become circumscribed between the European Airbus on the one hand and the Boeing B 767 on the other. The fact is that Lockheed and Douglas are merely idling, except insofar as concerns the DC-9 Super 80, which could well mean their disappearance within a short time as major builders of civil aircraft and their transformation into subcontractors of Boeing and Airbus Industrie.

One-Third of World Market for Airbus

At Airbus Industrie, the situation is as follows: Orders for the A 300 and A 300-600 (an A 310-type modernized A 300) total 316 planes (239 firm orders and 77 options). The 150th A 300, which is to be delivered to Eastern Airlines, will be delivered within the next few days. The production rate now exceeds four planes a month, will increase to five a month next year, and will continue rising thereafter. The first A 310 is in final assembly, will fly in the spring, and will enter service in March 1983. Orders for it now total 153 (79 + 74). Forty airlines, distributed over the five continents, have thus ordered a total of 469 A 300's and A 310's; some 30 are now using A 300's. Based on the long-term needs of these 40 companies, the number of Airbuses of the two types they should be buying probably exceeds 700, which justifies as of now the contemplated future production rates (8 to 10 planes a month) and the positive outlook for the A 320, for which the A 300 and the A 310 are now opening the way to the marketplace.

An analysis of the long-term market (that is, projecting it to the year 2000), based on an a 5.5- to 6-percent average annual traffic growth, yields the following results with respect only to the short- and medium-range planes that will then be in service:

--Category A 300 (250/300 seats): 704 planes, 360 of which only for airlines that are already clients of Airbus Industrie. This would leave 344 planes to be divided between Airbus Industrie and Boeing;

--Category A 310 (200/250 seats): 1,610 planes, 347 of which for airlines that are already clients of Airbus Industrie, leaving 1,263 planes to be divided between Airbus Industrie and Boeing;

--Category A 320 (130/180 seats): 2,341 planes, 768 of which for airlines that are already clients of Airbus Industrie;

--Category TA 9 (300/350 seats): 1,477 planes, 604 of which for airlines that are already clients of Airbus Industrie.

Assuming the 40 airlines remain loyal to the European consortium, out of a grand total of 6,132 short- and medium-range planes, 2,079 planes may be expected to be placed in service by these 40 companies. Of these 2,079 planes, as we have seen, Airbus Industrie has already placed 316 of its A 300's, 153 of its A 310's and 50 of its A 320's; thus, the European consortium should expect to deliver between now and the year 2000 a total of 1,560 planes: 44 of its A 300's (and A 300-600's), 194 of its A 310's, 604 of its TA 9's and 718 of its A 320's...

Of course, subject to the actual needs of the purchasers, there could be more need for A 300's and A 310's and less for TA 9's, particularly if traffic does not grow as fast as projected. On the other hand, other purchasers may be expected to join the present 40 airlines! Some, however, may go to Boeing or, more simply, may not wish to be tied to a single supplier; the latter supposition would favor Airbus Industrie, since it is Boeing that has the greater number, by far, of exclusive clients.

The assumption of a total of 2000 planes to be supplied out of a grand total of 8000, or one-third of the world market, thus appears very reasonable; and the chances are very good that Airbus Industrie will actually do better... .

The 4,053 remaining planes thus represent, at best, the planes to be furnished by Lockheed, Douglas and, above all, Boeing; but here again, the figure also includes the planes already delivered and, in the case of those to be modernized, already in service—for example, the DC-9 Super 80's (110 sold to date), the B 727-200 RE (up to 800) and, very probably, the DC-10-10's and L-1011, likely also to be re-engined.

The problem for Boeing is therefore to actually place the largest number of planes out of this total of 4,053. If we assume that Douglas will finally place 200-300 of its DC-9 Super 80's and that 200-300 DC-10-10's and L-1011's are likely to be re-engined, as well as 400 Boeing B 727's, this means that at best, 3,000 (and possibly many less) planes will finally be left for Boeing to sell. Subtracting the B 767's and B 757 already sold—to date, 311 of the B 767's (173 + 138 options) and 199 of the B 757's (138 + 61)—this leaves Boeing with 2,500 planes to sell...

For a builder of the magnitude of Boeing, in a semi-monopolistic position for the past 10 years, a comparison of the figures shows that the challenge represented by Airbus Industrie is an extremely dangerous one for the said builder. The most convincing evidence of this is that after having over these many past years referred condescendingly to the A 300 as a non-negligible competitor, Boeing has now taken in most cases to pretending the European competitor does not even exist: A tactic that betrays a certain fear... .

9399

CSO: 3102/34

TRANSPORTATION

FITERMAN INTERVIEWED ON AIRBUS INDUSTRY EXPANSION

Paris AVIATION MAGAZINE INTERNATIONAL in French 15-Jl Oct 81 p 19

[Interview with Charles Fiterman, minister of transport; name of interviewer, place and date of interview not given]

[Text] [Question] In the aeronautics sector, there are expectations that the A-320 program will be launched officially toward the end of this year. Where exactly does this stand and, in your opinion, what are the problems involved in launching this plane?

[Answer] Preparations for embarking on the A-320 program are proceeding normally. As you know, I met with my British and West German counterparts in July on this matter. As you also know, the problem was brought up outside the agenda of the Franco-British summit held at the beginning of September.

The concerns of the moment are: The obtaining of new market orders, the technical specifications of the new plane, and the development of Airbus Industrie's industrial organization and of cooperation within the GIE [Economic Interest Group]. True, we are in an economic situation that presents difficulties. But we are all in agreement in recognizing—and this is not new—that there is a substantial market for this type of plane between now and the end of the century. This is why the difficulties can in no way be allowed to constitute an obstacle to the bringing out of this plane.

Now as to the date by which we should be in a position to decide formally on the launching of the program: A tentative agreement has been reached to meet again toward the end of this year. And I hope we will be in a position by then to take the necessary decisions without undue delay. In any case, France will do her utmost toward that end.

[Question] The British and French governments have announced recently that they would like to have a substantial share in this program. Across the Channel, there is even talk of Great Britain participating to the extent of 30 percent. What is France's position in this respect?

[Answer] Great Britain's initiative in stating its intent to take a substantial part in this program attests the interest it has in bringing this new plane out on the market. France is very pleased to know this. And I can tell you that the French government is prepared to back a sizeable participation in this project. Let me remind you that we are now participating in the Airbus programs at a level of 37.5 percent.

Of course, we have not yet decided the percentage of our participation in the A-320 project, since it will depend on the different partners and the extent of their participation. But in any case, France is ready to take its full share.

[Question] In fact, as regards the partners, the FRG, which participated in the first Airbus programs, is showing signs of a certain reluctance with respect to this new program. If the FRG were not to participate in the development of the A-320, would you favor limiting the program, to the extent it can be limited, to a joint French-British effort, or broadening the joint operation to include other countries, indeed even non-European countries?

[Answer] The Germans are presently having problems of a budgetary nature. This explains their relative caution. However, the fact is that during the discussions we had with them in July they reaffirmed their intent to go ahead with detailed planning on the A-320 project; hence, their attitude toward it is positive. That being said, as far as we are concerned, we are open to any proposed broadening of the partners—with no prior reservations.

[Question] Once it is decided to go ahead with the plane, it will need an engine. Recently, you referred to the possibility of a joint French-British undertaking in this domain. Can you give us some details on this point, taking into account of the fact that the engine manufacturers that would be involved in this operation (SNECMA [National Corporation for Aircraft Engine Design and Construction] and Rolls-Royce) are already engaged in joint operations aimed at developing engines specifically to fill this gap?

[Answer] The cooperation that exists between SNECMA and General Electric for the CFM-56 is highly fruitful. And, from our governmental point of view, we hope it will continue, to include the development of the CFM-56-2000 for the A-320.

Nevertheless, we have before us a British proposal to explore the possibilities of a joint operation among Rolls-Royce, SNECMA and General Electric to develop engines of this type. I can say that we have no prior reason to refuse such an approach. True, an operation of that nature would pose a number of problems. But from the standpoint of the principle involved, the French government feels possible Franco-British cooperation in this domain could be very interesting, provided it did not upset existing cooperation or slow the development of certain programs.

[Question] Let us suppose the plane is to be built. In the event the French government were to give the green light to the development of the CFM-56-2000 the decision must be taken in time for the engine to be delivered in 1986. What is your thought on this?

[Answer] The French government--and you will see this in the 1982 draft budget--is disposed to do everything in its power to ensure that the production schedules of the plane and the motor are brought together and that they are completed in the shortest time possible.

[Question] A developmental program for a plane and one for an engine add up to a considerable cost. Does the government consider this program a priority matter?

[Answer] It is indeed a priority inasmuch as the overall priority of the government's policy is to create jobs. And it is evident that the development of new initiatives in the field of aeronautics construction will lead to the maintenance and creation of a not inconsequential number of jobs. In the 1982 draft budget that is to be submitted to Parliament, this section is being increased by 55.4 percent.

[Question] But if one considers the figures, all of this adds up to a substantial cost. Will it also be possible to go ahead with the ATR-42 commuter plane?

[Answer] I do not think it can be said a priori that all of this is costly. For it is not a matter in the case of the Airbus programs of pouring funds down the drain. As in the case of the A-300, and then of the A-310, the A-320 must within a certain length of time lead to a return on the Airbus programs. That is its objective.

I recognize, of course, that the investment that is indispensable to the launching of such programs is an obviously large one. But I am convinced that the future of our economy depends upon developments of this order.

Insofar as concerns the ATR-42 program (a program we are planning to develop jointly with Italy, and which is clearly much smaller in scope, hence in cost), proposals are due to be submitted to us shortly by the industrialists. And if those proposals prove viable, the government will take the necessary decisions to ensure that the development of that plane, for which there appears to be a market from the international standpoint, is not delayed--even though the 1982 budget, as presently drawn up, does not take into account the development of this new plane....

9399

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TRANSPORTATION

VFW PERFORMS GROUND-BREAKING WIND TUNNEL TESTS FOR AIRBUS

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 13 Oct 81
p 5

[Article: "How Flow-Favorable Are Running Engines?"]

[Text] United Aeronautical Works, Ltd, Bremen--In the VFW's [United Aeronautical Works] wind tunnel, engineers have succeeded in making flow measurements on an experimental Airbus wing with the help of a new type of experimental engine. According to VFW, the results of those measurements demonstrate precisely for the first time the performance of wide-body aircraft during takeoff and landing. The factory in Bremen has an experimental instrument which is unique in Europe and which could make a substantial contribution to improving the performance of the aircraft in the Airbus family.

Modern engine development with increasingly higher bypass ratios (ratio between the cold and hot gas flow in the engine) has resulted in engines which--relative to the dimensions of the aircraft--have become increasingly larger. Thus, by necessity the engines must be placed closer to the wing. As a result, today the aerodynamic interactions between the engine, the pylon and the wing--so-called engine interference--play a substantial role in the overall resistance balance of the aircraft and thus have a substantial influence on the economical operation and competitiveness of a modern civilian airplane. This problem has forced the wind tunnel engineers to seek realistic engine simulation in the wind tunnel.

The most modern experimental engine currently available has been used for several months in the Bremen wind tunnel for experiments on Airbus configurations. This experimental engine--the model used has a scale of 1:16 in respect to the original engine--has a real fan which has the same performance data as the collecting supercharger of the large design. Thus, the secondary jet of the engine (the cold jet surrounding the engine), which basically is responsible for the interferences with the wing and the pylon, is totally simulated.

The difference from the original engine is concealed under the jacket. There we do not find the miniaturized gas turbine of the airplane engine, but rather a tiny compressed-air turbine which is driven by cold air. This air is fed into the engine through the wing of the wind tunnel model and the pylon at a pressure of about 25 bars. The shaft horsepower of the turbine is considerable; in the engine on a 1:16 scale, whose fan is about 12 cm in diameter, the turbine generates almost 80 hp. After expansion, the propelling air flows out of the primary nozzle of the experi-

mental engine and thus simulates the primary jet of the real engine. The speed of this experimental engine is almost 40,000 rpm.

The wind tunnel experiments with such an experimental engine are extremely complicated. The purpose of the experiments is to measure slight differences in resistance for various nacelle and pylon forms and arrangements. In order to be able to do any measuring at all of such resistance differences, which can be of considerable importance for the economical operation of an airplane, the thrust of the experimental engine must be calibrated with great precision so that errors in measurement do not mask the result being sought.

These experimental engines, called TPS's (turbine powered simulators) in the jargon, have been used to date to investigate engine interference in the cruising range in supersonic wind tunnels, according to a report from VFW. Application for the low speed range, thus for takeoff and landing conditions, was considered impossible because of the great influence of errors in measurement. According to the company's data, a special method of suspending the experimental engine in the wind tunnel, with force-free feeding of the propelling air, and specially developed computer programs for evaluating the measurements have increased measuring precision in the Bremen wind tunnel in such a way that even in the low speed range small differences in performance with various engine and pylon arrangements can be demonstrated and their causes recorded.

12124

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TRANSPORTATION

BAE SAVES TIME, MONEY WITH NEW PROCESSES FOR A 310

Duesseldorf VDI NACHRICHTEN in German 25 Sep 81 p 4

[Text] When the logarithmic expansion of a material exceeds 50 percent, it is described as superplastic. Many alloys can be expanded up to 2,000 percent of their original length without contracting or breaking. During diffusion bonding, the surfaces of the pieces to be joined react to effect a fusion of the metals through recrystallization, crystalline growth and diffusion. The bonding temperature is about 0.5 to 0.7 of the melting temperature of the material.

Superplastic titanium alloys are opening up a new path to more cost-efficient hollow-shell construction. Flat blanks can be joined in a press and expanded through the controlled application of force. British Aerospace is producing four jack cans for the A 310 Airbus using this method, which will save DM 5,000 per aircraft.

Two operations can be carried out in the same installation in the "superplastic forming and diffusion bonding" process, SPFDB for short. Both superplastic forming and diffusion bonding require pressure and high temperatures. It was therefore only a matter of finding materials for which the figures determining forming and joining are the same.

The aluminum alloy "Supral" is superplastic, but only a small amount of component weight can be saved. The strength-to-weight ratio of the titanium alloy Ti6 Al 4 V is considerably higher. Moreover, the material can be superplastically formed at the temperatures and pressures required for diffusion bonding, while being stretched up to 10 times its original length. When Ti6 Al4 V or titanium A-10 is heated to 950°C under protective gas, the oxide skin is absorbed and the surface reacts by flowing under pressure, which results in a structural bond with the other part.

The jack can, with its corrugated stiffenings (single-column photograph), is diffusion-bonded and pressure-formed in the same press. The container protrudes into the fuel tank in the wing where the jacks operating the leading-edge slats withdraw when they are retracted. The heated form holds the two metal blanks securely along the edges, except for the edge at the open end, so that they can be joined. Protective gas is then introduced between the unbonded surfaces, and under its pressure the sections are inflated until they assume the contours of the form.

The flange at the open end is welded on in a subsequent operation. The jack can is only two-thirds as heavy as one made conventionally, but is just as dent-resistant. The two pieces of metal are molecularly bound in the diffusion-bonded join, as if they were a single piece of metal. The joint is not permeable by liquid or gas.

Using this process, containers can be bonded and formed by hollow-shell construction, including a core, in one operation. The pieces which are to be used as ribs are surface-coated where diffusion bonding is not to take place. Above and below the rib pieces two other sheets are inserted for the outer skin. When the skin has been expanded by gas pressure to conform to the mold, the rib pieces are inflated. During the operation their structure resembles a quilt. The pressure of the gas is maintained until the ribs also assume their final shape.

Already 6.4-mm thick titanium sheets have been superplastically formed at gas pressures up to 21 bar. This can take from several minutes up to one-half hour with aluminum alloys. The gain in time is still considerable if integral construction can be replaced by hollow-shell construction.

On the average, 45 percent fewer man hours are needed when no rivets have to be inserted and machining work is no longer required.

British Aerospace estimates that by using the combined diffusion-bonding and pressure-forming process, 4 percent by weight of the parts previously made from aluminum can be manufactured more cost-effectively. The new process could also be more economical for 75 percent by weight of titanium alloy parts that are not made from forged pieces and 10 percent of the steel parts.

The Airbus container, which forms an unobstructed recess in the fuel tank for jacks, was bonded and pressure-formed in one operation from a titanium alloy, with the exception of the bottom flange.





Skin with internal stiffening: Between the outer skin pieces, two other pieces are introduced into the form, which is heated to 350°C (left); after the skin, which is diffusion-bonded along the edge, has been formed to the mold, the center pieces expand under gas pressure everywhere that they are not bonded together (center); following additional application of pressure, the core forms ribs where it is bonded to the skin.



All these parts were manufactured from superplastic titanium alloy by diffusion-bonding and pressure-forming.

9581

CSO: 3102/31

TRANSPORTATION

BRIEFS

MORE HIGH-SPEED TRAINS--The study of two new TGV [High-Speed Train] routes--one to the south and southwest and the other to the north--is to be accelerated following the request made by the president of the Republic that these two projects be revived. Modeled on the TGV-Paris-Lyon-South-East, the "TGV-Atlantique" has already been the object of detailed studies by the SNCF [French National Railroads]. This new route, which would put Rennes and Nantes just 2 hours away from Paris and 3 hours from Bordeaux, would represent 346 km of railway and would cost Fr 6 billion, according to current estimates. Starting at Montrouge-Chatillon at the southern edge of Paris, the new line would cross the Beauce and would then split into two branches at Vendome: one branch toward Saint-Pierre des Corps et Monts, south of Tours; the other branch toward Arnage, south of Mans ending at Laval, with a branch line going west of Arnage toward Sable by way of Angers-Nantes. The "TGV-Nord," which is at a much less advanced stage than the western route, it seems, was studied while the construction of the tunnel underneath the English Channel was being contemplated. The revival of the Franco-British tunnel project is therefore going to revive the study of the TGV-Nord project, which will provide 462 km of new railway lines, 384 km of which would be in France and the rest in Belgium. Its cost has been estimated at Fr 6 billion. The Belgians, the Dutch and the Germans have indicated their considerable interest in this project, which could provide the beginning of a new high-speed international network across Northern Europe. TGV-Atlantique and TGV-Nord could be built within 6-7 years. [Text] [Paris AFP SCIENCES in French 24 Sep 81 p 44] 9238

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West Europe Report

SCIENCE AND TECHNOLOGY

No. 84



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WEST EUROPE REPORT SCIENCE AND TECHNOLOGY

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ELECTRONICS

CNET SPEECH SYNTHESIZER CIRCUIT MARKETED

Paris ELECTRONIQUE INDUSTRIELLE in French 15 Oct 81 pp 22, 24

[Article by L. P.]

[Text] The first samples of the CNET speech synthesizer integrated circuit were expected in October 1981. They will be produced by Thomson-Efcis as well as by Motorola.

Under study by CNET at Lannion for about two years, this circuit synthesizes by linear prediction. At the recent Sicob and at the PTT booth, it was demonstrated in a remarkable way: as an operator entered words or a sentence on a keyboard, the circuit spoke the text in a loud and intelligible voice.

The circuit can be used either to voice recorded messages, or to synthesize words through assembly and treatment of phenomena or diphones.

Its characteristics are:

Standard 24-pin package; n-channel, silicon-gate MOS technology; all inputs and outputs TTL-compatible.

The required command rate is 4800 eb/s; it can be reduced to an average of 2400 eb/s by external treatment of control parameters.

Two output signals are provided: one to a linear analog digital converter (12 eb sampled at 8 or 10 kHz), the other to an MIC converter. An external excitation makes it possible either to obtain a better quality of synthesis, or to consider the component as a digital filter whose transfer function can be continually changed (as for words), or not; in that case, any input signal can be treated by the desired transfer function (musical applications).

The configuration of a voice response system depends on the complexity and number of messages to be issued.

A simple application such as a talking clock, achieved with 40 seconds of speech (or 12 Kbytes for a compressed rate of 2400 eb/s), can be built in small batches on a 10x15 cm card.

A more complex application, requiring a large memory, raises the problem of selection of a basic vocabulary. If the memory exceeds 100 Kbytes, diphone synthesis will be preferred for its unlimited vocabulary extent (the size of a diphone library is on the order of 100 Kbytes).

In the application of a language dictionary, for instance, the addition of spelling-phonetics translation programs enables users to issue any voice message entered into a keyboard in conventional spelling.

Applications: especially telephone ones to begin with. Compared to a conventional technology of discreet components, integrated circuit technology makes it possible to reduce price (by a factor of 100), size, and consumption, and to improve reliability. The voice quality provided by the integrated circuit is at least as good as that obtained with synthesizers built by discreet technology.

Data acquisition remains costly. In the near future, however, coding will also be achieved with an integrated circuit.

Notably, in the proposal of an "intelligent dialog" with a telephone exchange, it will be possible to include in the subscriber's set integrated circuits for analysis and synthesis, so as to provide a complete function of automatic recording-answering machine.

In telecommunications, the circuit will also be able to issue "invitations to dial," announce new numbers, indicate rates to be paid, inform, decipher coded messages, and so on.

Other applications are the supervision of industrial processes, broadcasting of announcements, automotive installations (to warn drivers of unusual circumstances), and the control of experiments. But it could also be widely used in information processing, assistance to the handicapped, and so on.

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CSO: 3102/49

ELECTRONICS

BRIEFS

GALIUM ARSENIDE SENSOR--Whereas most Hall effect generators are built on indium arsenide (InAs) or indium antimonide (InSb) substrates, Siemens has just developed a sensor of this type on a gallium arsenide (GaAs) substrate. The KSY 10, whose sensitivity reaches 200 V/AT, senses magnetic materials through a Hall-effect generation of a voltage directly proportional to the magnetic field and to the control current. This makes it possible to determine the position or speed of gears or racks, as well as the displacement of diaphragms in pressure devices. Moreover, because it is thin (1 mm thick), it can be inserted into the yokes of current converter magnets, thus making it possible to obtain intensity measurements. Unlike conventional Hall effect generators, which require chemical processing to obtain different zones isolated from one another on a chip, the active zones on the KSY 10 are obtained by local ion implantation in GaAs. Since the active zones are symmetrical, the connections corresponding to the Hall effect and to the control voltage are interchangeable. Presented in a miniaturized plastic package, the KSY can operate up to 150 degrees C. At this temperature, the thermal coefficient of the internal resistance does not exceed +0.08 percent/degree K, and the thermal drift of the unloaded voltage remains low. [Text] [Paris ELECTRONIQUE INDUSTRIELLE in French 15 Oct 81 pp 10, 12] 11,023

CHIP PRODUCTION FACILITIES--Enschede, November 10--The Netherlands has the potential of becoming one of Europe's chief suppliers of production facilities for the micro-electronic industry, according to a report sent to the Ministry of Economic Affairs. The report, drawn up by the Twente technological university, said this new branch of industry already embraced 44 firms with a combined workforce of about 2,000. It said the industry's sales and workforce could grow by about 25% annually. Together the firms market a full range of chip production equipment and material, it added. To make full use of existing opportunities the university's researchers emphasise the importance of close cooperation of the firms with Philips, the Dutch electronics giant, taking the lead. [Text] [The Hague ANP NEWS BULLETIN in English 10 Nov 81 p 4]

CSO: 3102/56

ENERGY

DENMARK BACKS DISTRICT HEATING, WIND POWER

Duesseldorf VDI NACHRICHTEN in German 9 Oct 81 p 24

[Article by Walter M. Lehmann: "Denmark Backs District Heating and Wind Power"]

[Text] While the countries of the European communities are dependent on imports for about 55 percent of their energy, about 95 percent of primary energy consumption in Denmark is met by imports. This explains the great efforts being made by the public and industrial sectors to make energy available to the population of this relatively small country under conditions of optimal safety and at low cost.

Danish energy policy has to be seen in the context of the international commitments that derive from membership in the European communities and the International Energy Authority. Member countries have accepted the mutually binding responsibility of pursuing a strict energy policy, with the goal of reducing their dependence on imported energy.

Denmark's development into a predominantly industrial country, which began after World War II, led to a considerable rise in the standard of living and in energy consumption, which increased by 6 percent annually between 1960 and 1973 and declined to 1 percent annually after the oil crisis. After a period in which oil and oil products met 89 percent of Denmark's total energy consumption, coal became important again, and its use is expected to increase further. Oil makes up about 80 percent of total Danish energy consumption, which is the equivalent of more than 20 million tons of oil. The balance is made up almost exclusively by coal imported from Poland, South Africa and Australia.

The sharp rises in world market prices are passed on in full to households. The increases are being supplemented by higher taxes to hold down energy consumption. Ordinances in the areas of housing and commerce contain stricter regulations concerning the insulation of new buildings, the installation of energy saving devices in public buildings and subsidies which home owners can receive to carry out heat insulation measures. In the industrial sector there is also comprehensive legislation on investments to secure energy. It contains measures on subsidies and tax credits. Danish authorities also place great importance on improvement of public transportation. For example, a plan to electrify the main railroad lines will contribute to the replacement of oil by electricity which comes from coal-fired plants. Speed limits on the roads have also been lowered.

In 1979, a nation-wide heat plan came into effect. It forms the basis for the development of energy-heat coupling and of gas heating and it also contains guidelines for determining the most suitable heating system for each area. Particular attention was paid to the expansion of the district heating network as development continues, particularly after World War II. Current long-term plans are looking to supply 32 percent of the energy for heating purposes from heat generating plants, about 40 percent from gas and about 28 percent from oil by the year 1995.

According to the plans of the Danish electric companies, district heating will grow many times over by 1995. The illustration shows the target plans for the period from 1977 (shaded) to 1995 in terajoules per year, in which Copenhagen has the highest share, with 8,344 terajoules per year, and Apenrode has the lowest, with 382 terajoules per year.

These are the current percentages for sources of district heating in Denmark, which has been among the leading countries in district heating for decades: Oil-fired heating plants 54.8 percent, gas heating 0.1 percent and power-heat coupling 38.0 percent, burning solid waste 5.0 percent and waste heat from various sources 2.0 percent. Expansion of the district heating network is not least a transportation problem, which Denmark is solving successfully: Today it has about 20,000 kms of district heating conduits, the equivalent of 40,000 kms of pipeline, with a total heat volume of 67 petajoules per year.

This development necessarily brought up the question of economically optimal construction for district heating lines, which use foam concrete, mineral wool or polyurethane foam for heat insulation and whose protective covering consists of a concrete trench, asbestos cement pipes, plastic or steel. Objective information about the durability of the different pipe systems was provided in a study by the Swedish District Heating Association, which gathered statistics about damage occurring in several conduit systems between 1968 and 1978. The plastic clad pipe system showed itself to be clearly superior, compared to the foam concrete and the mineral wool-insulated concrete trench and the asbestos cement pipe system.

One can take as an example the pipe system of the I. C. Moeller company in Fredericia, a subsidiary of BBC [Brown, Boveri & Co], outstanding for its production of 1.2 million tons per year and an increasing share of the European market. This prefabricated laminated system consists of a heat-transporting pipe and hard polyurethane foam insulation, which is protected by an impact resistant, elastic polyethylene envelope. Long-term tests have shown that this system absorbs loads occurring in the ground, including changes in axial thrust. It is laid directly in the ground, on a stone-free sand bed, with a cover at least 40 cms deep. A built-in alarm system reports positive leaks or mechanical damage and supervises pipe construction during the assembly stage.

The city of Fredericia offers an impressive example of industrial heat recovery. As a result of agreements between the communal district heating head office and Superfos AS, which produces mainly fertilizers, it was possible to utilize large amounts of waste heat, for example, from exothermic reactions in the manufacture of sulfur and saltpeter, which was previously dumped into the Little Belt. Under the terms of the agreement, Superfos AS will feed 419,000 gigajoules annually into the municipal district heating network. A second Superfos project will meet the city's total needs, with an annual volume of heat of between 710,000 and 840,000 gigajoules. This is equivalent to a saving of 21,000 tons of oil. Expansion of the network will be carried out using the I. C. Moeller system.

The so-called Asnaes project, which is now in the planning stage, seems to refute the prevailing opinion that district heating is economically acceptable only over a limited distance between producer and consumer. It will link a heat generating station in the Kalundborg area with Copenhagen through four pipelines (diameter 1,016 mm) over a distance of about 100 kms. Although it is only a plan at present, it deserves attention, since the project is the subject of serious deliberations.

Subsidies for Windmills

The efforts of our neighbor, which is poor in primary energy, to generate supplemental energy can also be seen in intensive state subsidization of wind-powered generating plants, which, it is hoped, will provide 10 percent of the total electricity generated in the 1990s. Today, no fewer than 25 companies in Denmark are involved in the development and construction of wind-powered generating plants. A number of small plants are being tested free of charge in the National Laboratory at Risoe. With one exception, these windmills are all equipped with asynchronous motors, which are tied in directly to the public grid as generators. The certification of these plants and the crediting of electrical costs are subject to legal regulation. In the summer of 1979 a law was passed to control state subsidization of small windmills. The purchaser of a windmill is reimbursed for 30 percent of his expenditures, up to a maximum of 100,000 Danish kroner, provided that it is a certified, tested model.

Besides these small wind-powered plants with outputs of between 15 and 50kW, one plant in Gedser with an output of 200 kW, and two plants in Nive, each with an output of 630 kW are being operated under the state's wind power program. Ambitious Danish plans, which are based on a 10-percent share for wind energy in electrical generation in the 1990s, require the construction of 1,000 to 2,000 wind-powered generators with a height of 50 ms and a rotor diameter of 50 ms by 1994, so beginning in 1995, 150 to 200 plants must be built annually.

Denmark's attitude to nuclear energy can be described as ranging from cautious to negative as far as the construction of nuclear power plants is concerned. Nuclear research activities at the National Laboratory in Risoe are confined to the operation of two small reactors (2 kW and 10 MW) and a tokamak experiment, which is working in cooperation with the European "Jet" fusion project. Tests are being conducted in a pilot plant to process uranium ore from Greenland, and finally there is some research in isotope use and fuel element technology.

Denmark's heavy dependence on energy imports has led to early discussions of how these imports could be reduced by home-produced energy substitutes. Besides the efforts already described, one can mention the expansion of natural gas fields in the North Sea, burning solid waste and straw, the use of vehicles with hybrid propulsion, the use of heat pumps, improved heat insulation and regulation in buildings and the development of multipurpose stoves. The largest Scandinavian industrial fair, held in September in Herning, gave a comprehensive impression of Danish efforts in the area of energy with its exhibition "Danergi--Dansk Fjernvarme."



· Zuwachs der Lieferung von Fernwärme durch dänische Heizkraftwerke von 1977 bis 1995. Bild: Dänische Fernwärme

The growth of deliveries of district heat by Danish heat generating stations from 1977 to 1995.

9581

CSO: 3102/42

ENERGY

BRIEFS

WIND, SOLAR POWER COMBINED--When geographical conditions are unfavorable, it is possible to provide television programs only if they are brought in through a TV transformer. Siemens of Austria has found a unique solution to the problem which is sometimes encountered in supplying current for this type of booster transmitter. The combination of a solar panel with a wind-powered generator--both feeding a battery--makes completely autonomous operation possible. The concept is ideal for extreme conditions and is designed so that a transformer can still operate, even if there is no sun or wind for an entire week. [Text] [Wuerzburg ELEKTROTECHNIK in German 28 Sep 81 p 12] 9581

CSO: 3102/42

INDUSTRIAL TECHNOLOGY

NEW FAST-STEEL PROCESS BEING DEVELOPED

Stockholm NY TEKNIK in Swedish 1 Oct 81 p 16

[Article by Sonia Persson]

[Text] Molten steel is sprayed with nitrogen gas in a collecting vessel and hardens to a billet. This is the most important step in Fagersta AB's new fast-steel process-- a process to which the company has exclusive rights.

The process is only in the experimental stage. When the development work is complete, a method will have been produced that eliminates up to five manufacturing steps, compared to other powder metallurgy processes.

The process was originally developed by researchers at Osprey Metals Ltd. in Wales.

In the first step of the process, scrap metal and castings are smelted and mixed with alloying materials. The melt is poured into a runner box. The melt is then reduced to drop form by a stream of nitrogen gas. The drops are sprayed onto a mold. When the drops strike the mold they are flattened out and fused together to a substance that is ready for rolling.

Becomes Powder

The drops that land outside the mold solidify to a powder that is collected and reused in the process.

When fast steel is manufactured by other powder metallurgy processes, the steel must be treated in several different ways before it can be finished.

In the ASP steel process (a method used by Soderfors and described in NY TEKNIK 1979:13), for example, the molten steel is atomized and the drops allowed to solidify. The powder that is formed is placed in capsules. The capsules are vibrated and pressed twice, first in a cold press and then in a hot press. The capsules then proceed for forging and rolling.

"By decreasing the number of production stages, we can reduce costs," says Staffan Ekelund.

"The quality of our steel will be somewhere between ASP steel and conventional fast steel."

Good Quality

Fast steel is ductile and is used primarily in tools. ASP steel has even better qualities than ordinary fast steel.

The high quality may be achieved because more alloying substances may be blended with the steel in the powder metallurgy processes. The steel is atomized and the drops solidify rapidly and bind the alloying materials. Normally a high percentage of the alloy metals are separated and combine with the carbon to form grains that are interspersed among the iron crystals.

Much development work remains before the Osprey process can be used in normal production.

"One of the problems is to achieve the proper temperature for the metal drops. If they are too hot, they take too long to solidify and the material flows over the edges of the mold. If the drops are too cold, they form a powder," Staffan Ekelund said.

"This can be regulated by changing the distance to the mold. The temperature of the melt is about 1,500°C and it must be reduced to about 200°C.

Reach In 5 Years

If all goes well the process will be ready for production within a 5 year period.

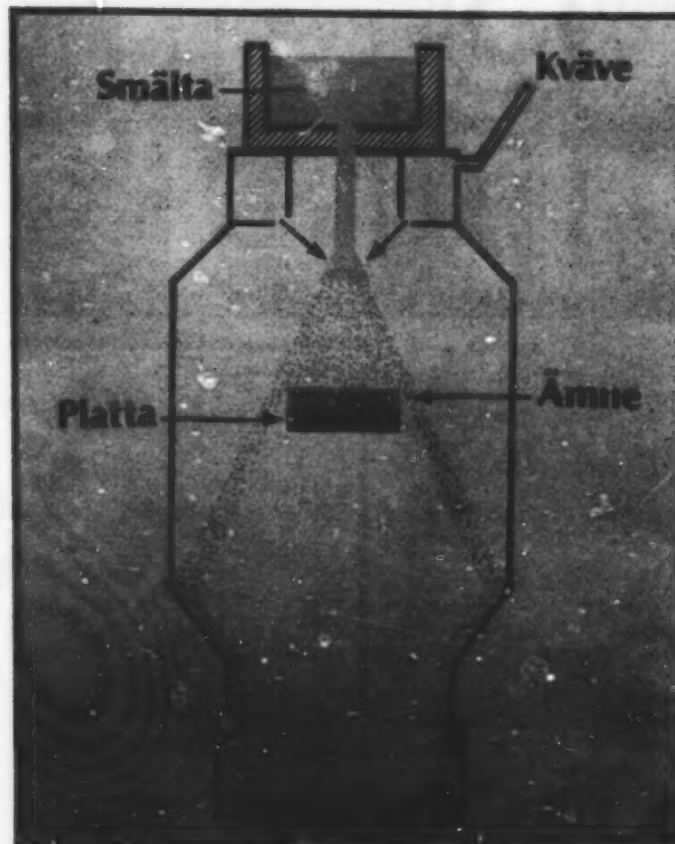
Much depends on how the steel is received on the market.

"If it is well received, we will produce a large portion by the Osprey method. Otherwise, the steel will complement our normal fast steel," head of steel research Bjorn Fredriksson said.

Fagersta is making wire and band with the steel. All the fast steel is produced in Langshyttan.

The band is used for saws, textile knives, and hacksaw blades. The wire is used in rotating tools, drills, screw taps, and end cutters.

"We do not plan to produce different articles when the new process begins. Our equipment is best suited to wire and band and we will continue producing them in the future," Staffan Ekelund said.



Sketch of the new fast-steel method.

Key to figure: A. Smälta = Melt
B. Kväve = Nitrogen
C. Platta = Plate
D. Ämne = Material

9336

CSO: 3102/37

BRIEFS

ELECTRICAL DISCHARGE MACHINING RESEARCH--The Electrical Engineering Laboratory of Paris, with assistance from the Ministry of Industry, is conducting basic research on the mechanism of removal of material during electrical discharge machining. The objective is to define the parameters involved and plan the design of adaptive control systems for these machines. Special topics for investigation include analysis of the propagation of heat away from anode or cathode discharge zones and investigation of the influence of static pressure on the erosion process. A fairly sophisticated experimental apparatus has been developed. In a parallel project, a predevelopment grant given to the Mecato-Alberici firm, at the Center for Technical Studies of the Mechanical Industries at the Electrical Engineering Laboratory of Paris has permitted the construction of prototype machinery for electrical discharge machining controlled by a microprocessor which operates by adaptive control based on real-time analysis of the discharge parameters. Thus it becomes possible to work at maximum metal removal rates while avoiding the formation of arcs which cause tool deterioration. [Text] [Paris *INFORMATIONS CHIMIE* in French Aug-Sep 81 p 103] 9828

ELECTROLYTIC PRODUCTION OF IRON--The direct electrolysis of iron ore pulp in suspension in a concentrated soda solution could provide a solution to the problem presented by underutilization of the nuclear power available during off-peak hours. This electrolysis is now being studied by IRSID [Institute of Siderurgical Research] with participation of EDF [French Electric Power Company]. The energy balance for this process is slightly more favorable than the energy balance for electrolytic production of hydrogen and direct reduction. For the technique which has given the best Faraday yield, the operating conditions are as follows: hematite ore, not goethite which readily forms irreducible ferrite (NaFeO_2) even at moderate temperature, with a gangue content as low as possible and siliceous, this ore being finely ground to 50 microns TV [vibrating screen?]; suspension: 1000 g water, 750 g NaOH, and 800 to 2000 g ore; temperature: 120-130°C, above which NaFeO_2 is formed; current density on the order of 2000 A/m²; terminal voltages below 2 V. Under these conditions the Faraday yield exceeds 80 percent, the remaining 15-20 percent serving to produce hydrogen, which is recovered; the consumption of electrical energy is about 3760 kWh/t as compared to 3600 thermies/t in conventional reduction of high-grade ore. [Text] [Paris *INFORMATIONS CHIMIE* in French Aug-Sep 81 p 103] 9828

CSO: 3102/33

SCIENCE POLICY

INTERVIEW WITH FRENCH MINISTER OF RESEARCH, TECHNOLOGY

Paris SCIENCES & AVENIR in French Oct 81 pp 48-50

[Interview with Minister of Research and Technology Jean-Pierre Chevenement by Francois de Closets, date and place not specified: "I Am Betting on the Scientific Spirit"]

[Text] S & A [SCIENCES & AVENIR]: With a budget which is receiving a healthy increase, you are a happy version of the prime minister of science I met a long time ago. You are going to be making some choices, defining some priorities. What will be your nonpriority sectors?

Chevenement: I quite understand the drift of your question, but I don't intend to define my priorities like rabbits pulled out of a hat. The method I have chosen is the concerted action approach. That is why I have organized a large nationwide colloquium to take place in stages spread out over a period of time and geographically decentralized on a regional level. This broad consultation will give us a much clearer perspective by the beginning of next year.

Nonetheless, for the time being, I have worked out a nonexhaustive list of six priority sectors which have received the approval of the Council of Ministers. Furthermore, I should mention that as far as I know these choices have not come under any criticism. Four of them concern avenues of industrial and technological advancement: robotics, electronics, biotechnologies, and, finally, new energy sources and rational utilization of energy. The other two priorities have to do with the model for society. The first concerns employment and changes in working conditions. In this area Germany is making a commitment ten times as great as France. Thus we certainly have a long way to go, and that corresponds closely to the policy orientation of our government. The second concerns the orientation of our research in relation to the needs of the developing countries.

In any event, it is appropriate to make an enormous effort to correct existing deficiencies in the operation and equipment of publicly supported laboratories. This does not mean being extravagant. On the other hand, it is necessary to accord basic research its proper place. Finally, there is a need for a greater commitment in some neglected sectors, such as the social sciences for example. So you see, to answer your question, I would say that France cannot decide to play one area against another. This is typically the kind of decision that one always lives to regret.

S & A: The research structures in France with these big institutions operate in effect like "funding siphons;" what margin do they leave to the discretion of a minister-- 3 percent, 5 percent, 10 percent of his budget?

Chevenement: I don't want to frame the question in that way. Don't forget that the budget of the Ministry of Research and Technology will include allocations for nearly all the large institutions. This is a watershed innovation. As a result, we will have the opportunity to influence the very structure of these budgets, and thus the policies of these large institutions. We thus have a responsibility to become directly involved at the very heart of the policies followed by these institutions and not just intervene through the side door on the basis of overall budget figures. The ministry is a center for stimulation which exercises its influence on the core and not just at the periphery. I have already organized one meeting of the principal directors of research institutions, and I hope it will become monthly.

S & A: Sixty percent of research is done in industry. Do you think this percentage is reasonable, too high, or insufficient?

Chevenement: It is approximately what is found in all the other countries, but there is not much sense in speaking in percentages. This is 60 percent of what? All the evidence suggests that the outlay for industrial research must be increased, and I am relying heavily on the national enterprises to fill that need.

S & A: With the new nationalizations, the national enterprises will be receiving half of the government research allocations...

Chevenement: More precisely, the national enterprises account for half of the expenditures for research from all enterprises. This is considerable, and this is only the beginning. Many of the nationalized enterprises ought to spend two or three times what they now spend for research and development.

S & A: But then the share of research credits spent in industry would end up being more than 60 percent of the total. Is that what you want?

Chevenement: No. In an initial stage the greatest effort will take place through the national budget. It is necessary to give it some time. Our objective is to increase our total research effort to 2.5 percent of the gross industrial product by 1985. Thus we must see to it that industrial financing of research develops very rapidly starting next year. That may seem very ambitious, but don't forget that the Japanese aim to reach 3 percent on the 1990 horizon.

S & A: In sum, you hope that the present government effort will set an example for the private sector?

Chevenement: Setting aside some of the complexities, yes.

S & A: Aren't you bothered to see public research funds go to private industry?

Chevenement: I detect that behind your question there is...

S & A: This is what many researchers at publicly supported laboratories are saying.

Chevenement: Listen, if it is a matter of giving money to some enterprises without controlling how they use it, that bothers me. But if it is more a matter of coupling the research effort with economic and social development, not only does that not bother me, but I believe it is absolutely necessary.

S & A: Sixteen percent of the research credits are earmarked for the military. How do you feel about that?

Chevenement: That is less than in England.

S & A: Yes, but much more than in Germany or in Japan.

Chevenement: Those two countries were on the losing side in the last world war. As far as France is concerned, we must make a commitment to defense to safeguard our independence and, therefore, must pay the price. But I do not think research expenditures will be the most excessive items in the military budget.

S & A: Do you believe in fallout from the space program?

Chevenement: I believe that in the United States it has had some beneficial effects on certain enterprises in the private sector.

S & A: Two-thirds of the public funding for industrial research goes to the aeronautics, 4.5 percent to the mechanical, and 2.5 percent to the textile sectors. Do you consider that normal?

Chevenement: In France aeronautics and electronics are the sectors which absorb the bulk of the funding. It is clear that certain sectors cannot be developed without an enormous input of government funding. What is disturbing is the inadequacy of the research in the other industrial sectors, particularly in what are incorrectly called the "traditional sectors."

S & A: Yes, but it is astonishing, if not shocking, that for 20 years one part of the French industry would constantly be stimulated with public funding and the other part not receive anything.

Chevenement: That does not necessarily keep it from crumbling apart. You see what is happening in consumer electronics. Nevertheless, in this area there is still some hope that an infusion of public support will turn the game around.

S & A: The fact is that we are the heirs of a scientific and industrial policy which has massively developed certain export sectors, but has left consumer industries in a state of neglect, so that now any attempt to revive them by stimulating consumer buying will risk throwing most of the profit to foreign companies, since our products are undercompetitive in these sectors. How then do you think research could help with the well-publicized efforts to recapture the domestic market?

Chevenement: That is in fact a difficult problem, since there we have to work on structures which are broadly scattered over the industrial sector. It is not enough to say "a great effort will be made in textiles," since once you have said that, you

still have to specify on what target and in what modality this effort will be applied. It may be necessary to provide aid to thousands of potentially innovative enterprises to assemble the conditions which would permit them to innovate effectively. To aid them, of course, there is ANVAR [National Agency for Valorization of Research] with a full grab bag of financial incentives, but that is not enough, and I am considering some new modes of action.

You see, I believe that first of all it is a human problem. The real problem is to bring about a change in the attitudes of the captains of enterprise. And that is why I am thinking in terms of some very flexible formulas: for example, dispatching technology advisers who would be at the disposal of the enterprises to help them overcome barriers that perhaps they could not overcome by themselves. These advisers would be in the nature of officials on loan to provincial enterprises. I myself have made an experiment of that sort in the Belfort district, and the results can be excellent if the advisers have the authority and the resources necessary to remove technical, financial, or administrative obstacles.

S & A: Do you believe in technical centers?

Chevenement: I believe in reforming them, in opening them up.

S & A: But do you think that it would be better to develop this collective research or enter into contracts directly with the enterprises?

Chevenement: Both. If the captains of enterprise realize that the research effort is their only chance for survival, then they should become competitive. I believe that in that way they may be able to recapture a certain number of the abandoned outposts by employing some better developed technologies. If the captains of enterprise understand that, then the game is won.

S & A: Does that come within the purview of your ministry?

Chevenement: Certainly--remember, it is called the Ministry of Research and Technology.

S & A: Let us return to the celebrated high technology sectors. Are you satisfied with the way in which they are being developed?

Chevenement: Our policy will be to see to it that these funds are utilized better. We need to devote our attention to enterprises which perform well in a worldwide context in a certain number of large sectors. These enterprises should in effect become poles of technological development. The Hanoun report pointed out how public aid to industrial research is concentrated to the benefit of about three large enterprises. This is one of the justifications for nationalizations. It is necessary to see that this public money is not distributed to enterprises which would use it in a questionable fashion without it having a positive impact on the balance of trade or on the employment. Here I could mention medical/surgical equipment, for which French products command only half of the domestic market. Yet here there exists an almost captive market where 80 or 90 percent of the business depends on the public sector. It is imperative that the public corporations develop and optimize their potential for research to create avenues for real technological advancement while sustaining themselves on the internal market.

S & A: Are you a proponent of the researcher for life, the tenured researcher?

Chevenement: Researchers have too often been saddled with a bad reputation. There has been a tendency to portray them as people who aspire only to work themselves into a good position. That is a caricature. Researchers certainly must not live in isolation. They should travel, go abroad. They should realize that their role also includes teaching, participating in the general business of scientific information. The researchers should realize that if the nation as a collective entity approves an exceptional effort for science, the effort should in return offer some positive pay-backs for the daily life of the people. The change, together with what it implies, namely the establishment of a society which exercises more control over its impulses, should have the result of making the relations between research on the one hand and production on the other much more natural. For that it will again be necessary to reform the status of researchers and dissociate career from function to a greater degree.

S & A: But aren't you worried that a degree of corporatism among scientists will paralyze the community confronted with hard choices, agonizing revisions?

Chevenement: There is perhaps a point on which we will not be in agreement: I do not believe in original sin. I think that the scientific community itself ought to be given the responsibility for exercising the most rigorous judgment over the works performed within its ranks; the best criterion for scientific evaluations is still the judgment passed on a researcher by his peers.

I am betting on this deep collective sentiment which is the scientific spirit, the sense of duty, the self-sacrifice of men of science, their devotion to their country. What counts most often is the spirit that sparks a generation of researchers, more than administrative measures or setting up false competition.

It is not possible to develop a high-performance research tool solely by manipulating certain market criteria. But I am as committed as you are to the proposition that there should be an ongoing evaluation of the quality of French research and that the money given to the research institutions should not be wasted. I will be more vigilant than anyone else on this point.

What is at stake is the competence of France. That is the meaning behind the effort we are in the process of making.

9828

CSO: 3102/33

SCIENCE POLICY

NATIONAL STRATEGY OUTLINED FOR DATA PROCESSING INDUSTRY

Paris AFP SCIENCES in French 24 Sep 81 pp 1-2

[Text] Paris. Chevenement: French data processing strategy. A coherent strategy aimed at the international market is necessary for the data processing industry, since it constitutes "a vital stake for the independence of the country, for social progress and individual freedoms," Jean-Pierre Chevenement stated 21 September in Paris.

The national outlets are too small--6 percent of the world market-- to be a sufficient catalyst for development, the minister of research and technology declared at the inauguration of the Data Processing Convention which is for programming what the Exposition of Office and Business Supply Industries and Office Organization is for supplies. To avoid such self-sufficiency, the minister recommended the signing of balanced cooperation agreements.

To put these new trends into practice, the government has set up an "Electronic File" task force whose first job is the creation of a national committee linking the ministries of industry, defense, communications, education and research. Similarly, task forces have been set up to deal with robotics and working conditions. The excessive conditioning of manufacturers by the national market, the weakness of research for components and peripheral equipment, the inadequacy at the most sophisticated levels and in microcomputerization, explain the backwardness of the French computer industry, Chevenement maintained. A "considerable but realistic" effort favors research over against profit margins and assurances about the future of CII-Honeywell-Bull, he remarked.

Currently, there are 1,500 researchers in data processing; "this figure is not enough," Chevenement declared.

Taking all budgets together, nearly 2 billion Fr will be devoted to research in data processing in 1982. Next year, funds for the NIRD? [National Institute for Research in Data Processing] will be increased by 30 percent and program authorizations by 56 percent. Thus the NIRD? budget will increase from 400 million Fr this year to 600 million Fr in 1982. Funds reserved for the "computerization of society" which come to 355 million Fr in 1981 will increase to 640 million Fr next year.

These funds available for research in data processing "will have a bearing not only on short term applied research but will be used more widely to intensify theoretical research," the minister emphasized. "The different schools of thought must rival each other in truly pluralistic competition since having the wherewithal does not comprise a laboratory's only means."

Industry and research should work together. But for some companies like CII Honeywell Bull, the research and development allocation, with an expenditure of 600 million Fr in 1981, is "barely acceptable," according to Francois Salle, assistant general manager for CII-HB. So much the more because the development cycle for research is very long, taking from 4 to 5 years in the area of data processing where technology undergoes rapid change.

Moreover, Chevenement developed his philosophy for the development of the data processing industry "which cannot be accomplished outside society and, even less, against it." This development implies "close collaboration with the users" since this field has been characterized by "a lack of communication and democracy for too long."

"For a technology to develop, it must benefit from a favorable social environment," the minister emphasized.

In the area of data processing research more precisely, the minister laid out the stakes.

"France," he said, "has specific advantages; it has the second largest word processing industry in the world, and as far as computers are concerned, it is in third or fourth place. That we have fallen behind in this area is the cause [sic] of faltering political determination and of too many changes of direction. But this lag is not irreversible; correction must be based on public enterprise which allows for the establishment of long-term plans (nationalization of CII-HB), on the IBM research centers in France, on the development of French data processing companies (CII-HB, SEMS, peripheral data processing) and finally, on service and word processing companies."

Chevenement has given an outline of what a coherent strategy for the French data processing industry could be. It rests on three rules:

First rule: reinforce strengths, the word processing industry and the telecommunications industry, and Matra's, Thomson's and CGE's developmental poles so as to encourage the large-scale development of computer communications.

Second rule: guarantee the independence and development capabilities in component substances, in particular of VLSI, and to accelerate the development of new technologies, as for example the lithography of bundles of electrons.

Third rule: guarantee the future of CII-HB by an investment and research effort representing several billion Fr between now and 1985, without much immediate return. It will therefore be necessary for French industry to learn to produce very powerful data processing systems and to that end to aim at fifth generation computers.

SCIENCE POLICY

RESEARCH AID GIVEN BY AGENCY TO INCREASE

Paris AFP SCIENCES in French 17 Sep 81 p 2

[Text] Paris. ANVAR has helped more than 2,000 companies in 2 years. In 2 years ago, the National Agency for the Valorization of Research had granted to companies more than 2,000 innovation grants for a total of about 1.2 billion Fr, said Christian Marbach, the general manager of the National Agency.

Next year there is to be a substantial increase in the funds placed at the agency's disposal, Marbach affirmed during a press conference. ANVAR's draft budget for sponsorships for 1982 in fact increases to 760 million Fr, as compared with 420 million appointed in the 1981 initial finances bill.

For the current year, moreover, the agency will be able to invest between 600 and 650 million Fr, thanks to the carryover from 1980 and the rectifying finance bill (+60 million Fr).

The National Agency has carried out a study of the 1,500 grants which were given during the 18 months following its reorganization (September 1979, February 1981) in anticipation of the "ANVAR Meeting" which will be held in Lyons next 15 and 16 October.

The "ANVAR Meeting" will allow particularly the heads of "innovative" companies and laboratories to consult free of charge with ANVAR specialists and with public and private consulting organizations. The event will be inaugurated by the minister of research and technology, Jean-Pierre Chevenement, and will be concluded by the prime minister. The minister of industry, Pierre Dreyfus, is also to meet those who take part in the "Meeting."

According to the study, the three areas of activity most frequently receiving aid from ANVAR include agricultural and natural products (a fifth of the grants), instrumentation and automation, and metallurgy engineering. The textile chemistry, building and public works group are among the least represented.

Three grants out of four went to a company outside the Paris area, and the Rhone-Alps region alone received 15 percent.

Finally, one out of four grants went to a business that was specially established on an innovation; hence, over the period under consideration, nearly 350 businesses owe their existence to ANVAR.

SCIENCE POLICY

FIFTY-TWO BILLION FRANCS FOR RESEARCH IN 1982

Paris ELECTRONIQUE ACTUALITES in French 16 Oct 81 p 3

[Article: "To Merely 'Bring It Up to Par': 52 billion Fr for Public Research in 1982"]

[Text] The public research and technological development effort, 52 billion Fr for 1982, is to be increased by nearly 30 percent in relation to 1981. This is what is apparent in the budget to be debated by the Parliament, a budget which, according to Chevenement, minister of research, constitutes an initial stage towards the objective the government has set itself, to increase the proportion of national expenditure for research and technological development in 1985 to 2.5 percent of the GDP [Gross Domestic Product].

This budget is characterized by "bringing up to par" research teams and by the "reconstruction of research apparatus." Consequently it gives a certain priority to employment and, otherwise, extends the funding of current projects, principally of aeronautical and space programs.

The slow progress in credit payments (only 15 percent) is nevertheless a matter of concern for Chevenement who thinks that corrections can be made there in the course of the year.

The research budget constitutes a sufficiently heterogeneous ensemble that the Research Ministry exerted itself this year to clarify in its presentation what has been made possible by its new powers.

All told, the state effort in research should reach about 52 billion Fr in 1982 (for program authorizations and ordinary expenditures). Out of this total, the amount designated for military research (about which no details are given) is estimated at 17.6 billion Fr, and remuneration for the researcher-teachers (dependent on the Ministry of National Education) at 6 billion Fr; out of the same total, 3.15 billion Fr are administered by the Ministry of Communications.

The so-called civil research budget comes down therefore to 25.4 billion Fr (+ 29.6 percent in 1981) and it is subdivided into two parts. The first is the interministerial research allocation, for 16.3 billion Fr (of which 77 percent is administered by the Ministry of Research, while the remainder is the concern of

various public research organizations, and nonbudget assistance funds); in this allocation are included notably all researcher related expenses (1,580 new jobs) and so-called ordinary expenses, which represent 10.3 billion Fr, while the program authorization expenses (support for programs and equipment) come to 6 billion Fr, with an increase of 32 percent.

The second part of the civil budget is concerned with technological development expenses, and comes to 9.1 billion Fr, which represents an increase of 35.8 percent; the Ministry of Research administers 69 percent, and the remainder figures in the endowments for civil aeronautics, the data processing plan, and the seabed mining program.

In the civil budget, program authorizations, i.e., expenditures already determined which can be carried out over a period of time extending beyond the fiscal year, should permit them, within the bounds of the interministerial allocations alone:

- 1) To proceed rapidly with the reconditioning of the research laboratories' operational apparatus which had seriously deteriorated over the last few years.
- 2) To complete the part envisaged for 1982 of the national and international scientific apparatus plan, particularly in the areas of physics, space and oceans, as for example the thermonuclear fusion reactor Tore Supra, the Lane-Langevin Institute (French-English-German) high flow reactor, the construction of the Millimetric Radio-Astronomy Institute at the National Institute for Astronomy and Geophysics, in cooperation with Germany; the installation of a vectorial calculator, the Super Aco, synchrotron ray machine, etc.
- 3) To begin research programs in the priority areas in which the Ministry of Research and Technology has just proceeded to establish task forces.

The 9.1 billion Fr in program authorizations for technological development are apportioned as follows:

- 3.39 billion Fr for the nuclear program (+14.6 percent).
- 1.74 billion Fr for the space program (+34.3 percent)
- 2 billion Fr for the civil aeronautics program, which will permit the go ahead with the A320 Airbus.
- 60 million Fr for the submarine mining program.
- 100 million Fr for the solar program (+53.8 percent), the total budget for the Solar Energy Commission being 300 million Fr (+50.7 percent).
- 658.3 million Fr for the data processing program; the National Institute for Research in Data Processing has 156 million Fr from elsewhere (+38 percent).
- 167.5 million Fr for the Data Processing Agency [DPA] (+20 percent' the DPA has a total budget of 280 million Fr (+31 percent).
- 827 million FR (+68.7 percent) for the National Agency for the Valorization of Research, and in addition the funds (90 million Fr) administered by the Innovation Delegation.

TRANSPORTATION

NATURAL GAS GAINING POPULARITY IN EUROPE AS AUTO FUEL

Stockholm NY TEKNIK in Swedish 1 Oct 81 p 24

[Article by Anders Wallerius]

[Text] Gas is now being used as an automobile fuel in Sweden and many other European countries. In Holland, which has the highest percentage of gas-driven automobiles in the world, there are already 400,000 cars using LP-gas (propane and butane). There is an equal number in Italy.

In addition, there are 250,000 cars in Italy operating on natural gas (methane). This alternative is of more and more interest, since natural gas is no longer burned at the oil field, but is utilized.

Natural gas has been used successfully in Italian cars since the 1950's. There are now 250,000 cars using almost 300 billion cubic meters of natural gas annually.

There are 220 natural gas stations throughout Italy. In the northern section of the country the average distance between stations is only about 10 km.

Unlike LP-gas, which is used in Swedish gas-driven cars, natural gas cannot normally be stored in liquid form. This would require temperatures below -164°C . To have a reasonable energy density, natural gas must instead be compressed under a pressure of about 200 bar.

Larger Tank

At that pressure, which is the normal pressure used in Italy, the volume of a natural gas tank is about four times greater than a gasoline tank of corresponding energy content. It weighs six times as much, however, since the natural gas container (gas bottle) weighs 1 kg per liter of stored gas. (Nevertheless, the weight is only 1/20 that of a lead-acid battery.)

In Sweden there is much less interest in natural gas for operating automobiles. Instead Esso, the large LP-gas dealer in this country is actively introducing LP-gas for automobiles.

"We see no point in using natural gas," said Roland Nyström, who is marketing director of Esso Gasol.

"First of all, there is no natural gas available in Sweden. Scania may not receive the first deliveries from Denmark until 1985.

Experience With LP-Gas

LP-gas technology, on the other hand, is available along with experience in the use of LP-gas. Production and distribution already exist, although on an insufficient scale, and the equipment (carburetor) for converting automobiles is simple and can be imported from Holland. LP-gas stations are the only thing lacking, according to Esso.

"The oil industry is not considering the use of natural gas as a fuel for automobiles," Roland Nyström said.

"If, however, natural gas is imported in large quantities the industry may reconsider.

Danish Interest

Denmark has already begun to reconsider. At least, the idea of using natural gas in automobiles has been raised, according to the Danish magazine INGENIOREN.

The Danish interest has been sparked by the discovery of large quantities of natural gas in Denmark's section of the North Sea. It is estimated that in 10 years the annual production of natural gas will reach almost 3 billion cubic meters.

The Danish natural gas will be used primarily for heating and industry, but it would be advantageous to use it in automobiles during the summer months. This would also decrease the need for oil.

9336

CSO: 3102/38

TRANSPORTATION

AIRBUS INDUSTRIE SAYS A320 PROJECT ON SCHEDULE

Features Taking Shape

Paris AVIATION MAGAZINE INTERNATIONAL in French 1-14 Nov 81 pp 50-51

[Text] The A320 program is moving ahead on schedule. Airbus Industrie officials at Toulouse are now more confident than ever that the new short- to medium-range transport will be available for mid-1986 delivery. Following discussions with a certain number of potential initial A320 customers, the consortium recently made an important design refinement: both of the proposed versions will now have the same seating capacity, namely 150 passengers.

After introducing the A320 program at the Paris Air Show in June, Airbus Industrie and its European partners continued their development and marketing work in a deceptively low-key manner. Actually the program is proceeding approximately as planned. While certain matters such as detailed sharing of the product work still have to be settled, multinational teams are, nevertheless, going all-out on the development phase. One team in Great Britain is hard at work on designing the wing, while another in Toulouse is defining the flight deck and systems. In other words, the aircraft's two most critical components are being handled by the most experienced teams, and the program will not be delayed by the longest phases of the operation, i.e., production drawings and orders for tooling and materials.

At the same time, discussions with various airlines have taken a more and more concrete turn which has enabled Airbus Industrie to make a major decision. Although initial plans called for two versions, each with a different seating capacity, potential customers and the consortium have now reached agreement on a single airframe seating 150 passengers in a mixed-class configuration. This definition will accommodate 12 first-class passengers in 36-inch pitch seats and 138 economy-class passengers in 32-inch pitch seating.

There are, still, however, two versions of the A320, but they differ solely in their maximum weight. The A320-200 will weigh 5,900 kilograms more than the A320-100, and will have a center-wing fuel tank giving it an additional range capability of about 1,000 nautical miles.

This decision will simplify the program and reduce both tooling and certification costs. It was prompted by the improved operating cost per seat of the larger

originally proposed version, thereby making it possible to lower capacity without any penalty in economical performance.

Considerable and favorable progress has also been made on another key point of the program, the aircraft's engines. This progress permitted Roger Beteille, Airbus general manager, to avert: "We will definitely have the engine we specify."

As is the case with the A320 airframe and its systems, Airbus Industrie wants a suitable new-technology engine making maximum use of current techniques or those whose availability can be assured for the aircraft's initial service entry in 1986. No great technological risks, but maximum use of all available technology: such is the motto for the program as a whole.

Airbus Industrie has conducted evaluation studies of all candidate engines jointly with their manufacturers, General Electric-Snecma, Rolls-Royce, and Pratt and Whitney. Although the findings of these studies have not been developed, they are reportedly close. Airbus Industries actually asked engine manufacturers for a custom-built engine optimized for the A320 and its mission. This means the future engine will not be optimized merely for cruise or climb but for the entire flight profile. Joint teams of technicians from Airbus Industrie and power plant manufacturers have worked on nacelle-engine-wing integration with this objective in mind. Airbus Industrie is now in a position to offer A320's with different types of engines. Engine selections will be made by the ordering airlines, not by Airbus Industrie. Such selections are expected to be made by late this year or early 1982.

Independently of its technical aspects, the program's industrial and commercial aspects still remain to be clarified. These matters are also about to be settled.

One sure thing is that the A320 will be built by Airbus Industrie's current partners even if new partners join the program. This firm assurance, which had not as yet been given in June, has obvious logistical advantages in that decision-making processes will remain unchanged.

As was the case in previous Airbus programs, the industrial agreement will be followed by a governmental agreement guaranteeing that industrial firms in each member country will be capable of carrying out their part of the program. This phase should be completed sometime next year, in other words by a date consistent with orderly implementation of the program in accordance with the announced timetable.

Of course, airlines still have to decide to place their initial orders. While Air France's public commitment to A320 purchases has thus far prompted no similar orders from other airlines, officials in Toulouse feel it has established the A320's credibility and facilitates discussions with other carriers. These same officials continue to believe that the absence of firm and credible proposals from competing airframe manufacturers is restraining airlines from making any purchase decisions. Nevertheless, the equanimity displayed by Airbus Industrie officials leads us to assume that the initial airline customers needed to launch formal production will be found and that they will announce their decisions in due time.

New A320's Characteristics

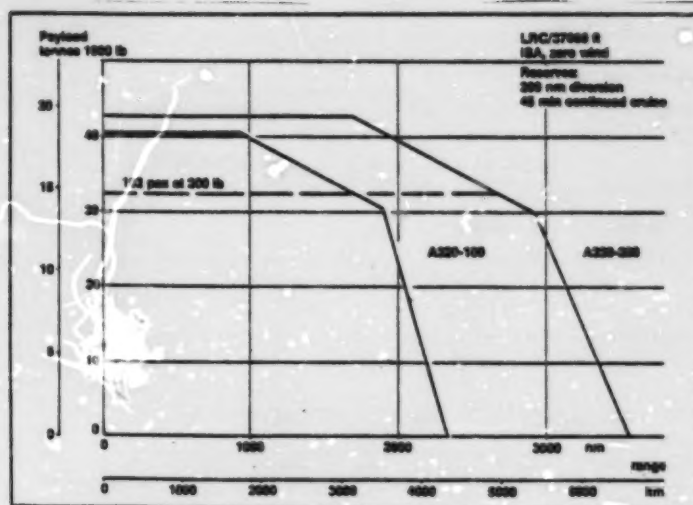
<u>Characteristic</u>	<u>A320-100</u>	<u>A320-200</u>
Wingspan	34.48 meters	
Length	37.41 meters	
Height	11.78 meters	
Max. take-off weight (kg)	66,000	71,900
Max. landing weight (kg)	61,463	62,863
Max. zero fuel weight (kg)	57,607	59,077
Operating empty weight (kg)	39,248	39,656
Maximum payload (kg)	18,359	19,421
No. of seats (32-inch pitch)	162	
Load: pass. & baggage (kg)	14,697	14,697
Additional cargo (kg)	3,662	4,724
Volume of cargo compartments		
a. Forward	15.09 cubic meters	
b. Aft	25.66 cubic meters	
c. Total	40.75 cubic meters	
Max. weight of fuel (kg)	12,900	18,800

Comparison of New A320-100 With Former A320-100, A320-200

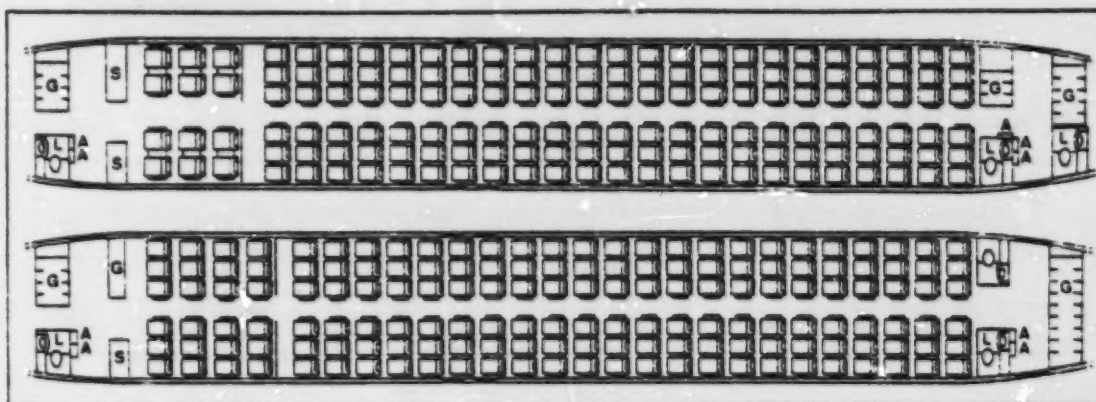
<u>Consumption & Costs</u>	<u>New A320-100 vs. former A320-100</u>	<u>New A320-100 vs. former A320-200</u>
Capacity (single class, 32-inch pitch)	+8 pass. +5%	-10 pass. - 6%
Fuel consumption (500 NM)	-6%	-12%
Fuel consump. per seat (50 NM)	-11%	- 6%
Stage cost (500 NM)*	same	- 6%
Stage cost per seat (500 NM)	-5%	same

*Typical European operation, single-class configuration.

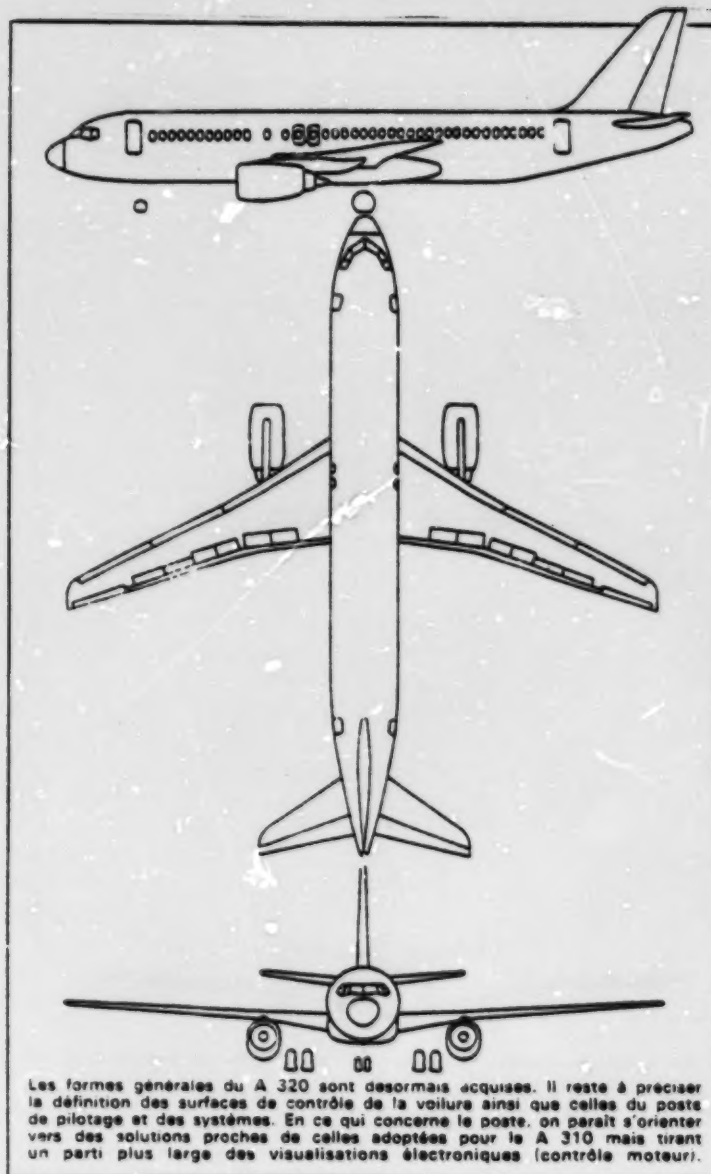
This comparative operative table shows how the 6-percent savings in stage cost, obtained by refining the A320's definition, offsets at cost-per-seat level the new aircraft's 6 percent lower capacity when compared with the A320-200's former definition. It was this improvement in design efficiency that made it possible to decide upon a single capacity for both the A320-100 and A320-200.



The main difference between the A320-100 and A320-200 comes from the additional fuel the latter can carry in its center-wing tank. With 162 passengers, each weighing 82 kilograms, the A320-100 will have a range of approximately 1,700 nautical miles (3,150 kilometers) and the A320-200 a range of 2,700 nautical miles (5,000 kilometers). The curves make provision for the following reserves: a 200-nautical mile diversion and 45-minute continued cruise, at long-range cruise at 37,000 feet, at ISA and zero wind.



Two possible types of mixed-class arrangements for the A320. Upper sketch: 150-seat layout accommodating 12 first-class 36-inch pitch seats and 138 economy-class 32-inch pitch seats. Lower sketch: 156-seat configuration with 24 business-class 36-inch pitch seats and 132 economy-class 32-inch pitch seats. For single-class 32-inch pitch seating, the aircraft can carry a maximum of 162 passengers.



The general lines of the A320 are now firmly defined. Still in the definition phases are wing control surfaces, cockpit, and systems. For the cockpit, designers seem to be moving toward solutions close to those employed in the A310 but with greater use of electronic visual displays (engine control).

Buyers Sought

Paris L'USINE NOUVELLE in French 12 Nov 81 p 75

[Article by Antoine Thiboumery]

[Text] Last May, Bernard Lathiere, president of the European consortium Airbus Industrie, assured L'USINE NOUVELLE that "our aircraft sales will reach the 500 mark before the end of 1981." With the recent announcement that the Lebanese carrier, Middle East Airlines, has purchased 19 A310's--five firm orders and 14 options--a total of 502 Airbus transports have indeed been ordered, thereby confirming the Airbus Industrie president's earlier forecast. Another of the consortium's officials recently told us: "The year 1981 will be an excellent one for us, better than last year. To such a point, that in high capacity aircraft we have just moved ahead of Boeing and thus taken over first place!"

Although this showing is altogether commendable, it must not make us overlook the hotly contested battle currently being fought by Airbus Industrie to sell its new program, the small Airbus, the A320.

The A320 program was officially launched last June on the opening day of the Paris Air Show. Since then, however, it appears to have slowed down. "Not at all," says Bernard Lathiere, "the decision-making process is under way, and everything is proceeding normally at the present time." In other words, the A320 is now technically complete, studies are finished and the aircraft is defined.

Technical Phase Ahead of Marketing Phase

On this last particular point, namely definition, Airbus Industrie, at the request of a certain number of airlines, has, in fact, recently redefined the A320 so that both versions--the A320-100 (150 seats and 3,150-kilometer range) and A320-200 (162 seats and 5,000-kilometer range)--will now have the same single fuselage, thereby reducing tooling and industrialization costs. While technical discussions have clearly progressed since the Paris Air Show, the same is not true for the program's marketing and political aspects. Airbus Industrie is still "working" intensively on those airlines that might be the A320's first buyers. As explained by consortium officials: "Orders from three airlines--Air France, Lufthansa, and Swissair--were sufficient to launch the A310. As for the A320, Air France is already prepared to order 50 of them. It would, therefore, take very little now for a formal production launch of the A320.

But isn't time running out? And how many more months can Airbus Industries wait? Roger Beteille, Airbus Industrie general manager, categorically stated in this connection that "the decision to build the aircraft has been made. If we have to make a new decision in the near future, it can only be not to continue the A320 program. Yet nothing today indicates we should be worried. Be that as it may, the final date on which we could make such a decision is March 1982."

Hence Airbus Industrie still has 5 more months in which to line up customers for the A320. These 5 months should also enable the consortium's different member

companies to decide upon their detailed sharing of industrial tasks. At this juncture, the Belgians and Yugoslavs might possibly enter this new program. But Airbus Industries officials claim that the "current partners working on the A300 and A310 are capable of also building the A320 by themselves alone."

The Japanese? They have been contacted. The ball is now in their court. But the Fokker-McDonnald Douglas team has made them some very attractive proposals. Under these conditions, will the Japanese opt for Airbus Industrie? Yet that is not the most important question. What is vitally important is the fact that to win, Airbus Industrie has to find one or two more customers.

Once this hurdle is overcome, the European governments concerned are not expected to oppose release of the funds--1.5 to 2 billion dollars--required for definitely launching the small Airbus program.

8041

CSO: 3102/45

TRANSPORTATION

FIAT VSS: REVOLUTIONARY CONSTRUCTION METHODS

Paris L'ARGUS DE L'AUTOMOBILE in French 15 Oct 81 p 10

[Article: " Fiat VSS 'Idea': a Revolutionary Method for Building Automobiles"]

[Text] Things are moving very fast at Fiat! On the industrial level, absenteeism has become so low that daily production is higher than the most optimistic forecasts--with the result that stock on hand is swelling and technical unemployment is going to be necessary! In Turin, after the redesign of the 131 and Argenta, the expansion of the Ritmo range, and the dieselization of the 127, the restyled 127 is expected soon, and especially the Uno, on which great hopes are founded. In the area of robotics, the Fiat subsidiary Comau is keeping its European "yellow jersey" and has just got into Sweden and--a world first--GM, with a flexible shop. Research is not being neglected, as is attested by the adoption of a volumetric compressor for the 131, the development of increasingly precise electronic controls for the power trains, and the imminent mass-production of the Transmatic transmission with infinite number of ratios.

But Fiat has just surprised us again with an industrial-research car named VSS (Experimental Car with Subsystems). To make things easier, we will give it its code name, Idea, first of all because it is a much nicer name and because it gives recognition to the people of the Idea institute who helped in working it out.

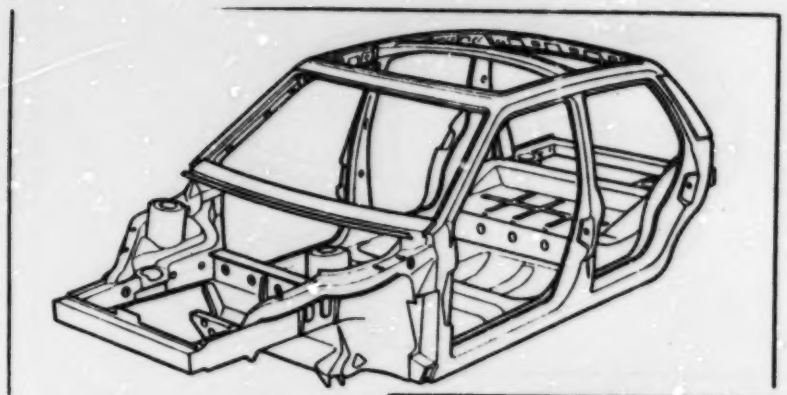
What is special about this Idea, built on a Ritmo mechanical base? First of all, it is 5 cm wider and 8 cm shorter overall; but the most important thing is that it is composed of a very solid metal frame onto which plastic elements are attached, with the whole weighing 21.3 percent less than a Ritmo! The word used now is "cage," rather than shell: the central part, of zincrometal, and the side-members, of high-strength steel, resist corrosion well but are as rigid as a conventional shell. All the elements of the "cage" can be stamped out by small presses and require only 1,800 welding points instead of the 3,000 for a normal Ritmo; the saving of time and money that this represents are obvious.

Better still: the doors and fenders, of SMC [Sheet Molding Compound], and the front and rear parts, of polycarbonate, form a plastic "skin" entirely resistant to corrosion that can be painted or tinted in the mass, but in particular, can be fabricated, element by element, in factories far away!

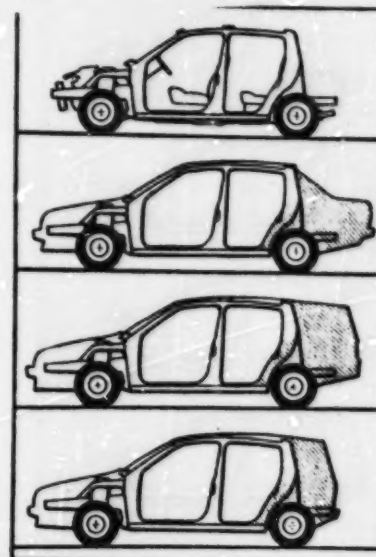
Thus, at the same time Idea achieves weight-savings and simplification of assembly thanks to its "subsystems" conception, and acquires a life expectancy of close to 20 years!



Without special research, the Cx [coefficient of drag] is 0.36. Assembly of a VSS: 5 hours less than for the Ritmo!



A "reticular cage" as solid as a shell but 20-percent lighter



These diagrams show how easy it is to change the rear of the VSS. Short version for town, van-type for vacationing, Idea could even revive the activity of the body-builders, who will easily be able to propose special versions of it.

Last but not least of its advantages is the fact that since the front and rear parts are bolted onto the steel cage, it is very easy to change them. The model can thus be "restyled" easily, and better still, can be transformed into three different volumes or into a van-type for vacationing, and the "short" rear can be put back on for the winter. As a corollary of the massive use of plastic (20 percent), in some cases glued to the cage (the roof), Idea is especially quiet.

What, then, is awaited before production is started up? In the present state of the market, it would be more expensive to manufacture (100,000 lira more, or about Fr 500) than a Ritmo, because of techniques not yet adapted to mass production; but the engineer Scolari has granted that around 1985, a number of ideas coming from Idea should be seen in the Fiat range: consider the fact that the hood (which also serves as fenders) is molded in one piece, whereas it takes 17 metal pieces to achieve the same result!

Good news for countries without an automobile industry that will be able to create one at low cost, good news for Fiat, which will be rolling back its costs, Idea truly deserves a place in the Pantheon of the automobile: it is far more revolutionary than a good many pretentious "research cars," for it prefigures what the popular car of the year 2000 will really be.

11267
CSO: 3102/40

TRANSPORTATION

BRIEFS

ATR-42 NEGOTIATIONS--The Franco-Italian local plane program well under way. A proposed agreement between the Italian company Airitalia and Aerospatiale to build the local transport plane ATR-42 is currently being discussed in Rome. Interministerial negotiations between the two countries took place at the beginning of October, after the meeting of the French minister of industry, Dreyfus, with the Italian minister of state enterprises. It is believed that the conditions set down by the two partners for the actual implementation of this program are well on the way to being met, since a dozen air companies, at least one of which is American, have shown interest and have secured options for the ATR-42. The decision to launch this program is to be made before the end of the year. [Text] [Paris ELECTRONIQUE ACTUALITES in French 16 Oct 81 p 10] 9824

FIRST FLIGHT OF FFCC AIRBUS--The first A-300 Airbus equipped with a forward facing crew cockpit [FFCC] designed for a two man crew has just completed its first flight. It is the first time that a heavy transport aircraft has been piloted by a crew of two instead of three. Intended for the Indonesian Garuda Company, this new cockpit incorporates cathode ray tubes which will also constitute part of the equipment of some A-310s, in particular those of which Swissair will take delivery beginning in 1983. The FFCC includes digital auto pilot systems and three "strap-down" course and altitude terminals. [Text] [Paris ELECTRONIQUES ACTUALITES in French 16 Oct 81 p 10] 9824

TESTS OF NEW ENGINE--The Hague--Automobile engines burning alcohol, gasoline or mixtures--The Dutch government has made 850,000 guilders (Fr 1.8 million) available to the Netherlands Institute of Applied Technology (TNO) for practical testing of a system enabling automobile engines to operate on alcohol or gasoline or any mixture of the two. The system, which has been developed by the TNO, will be tested on some 30 cars for a period of 2 years, the Institute's spokesman declared on 1 October. He stressed that good results from these tests will open up prospects for application of the system not only in Europe but in many countries outside Europe. The Netherlands Institute will try to establish production and sales of the new system in The Netherlands. [Text] [Paris AFP SCIENCES in French 8 Oct 81 p 44] 11267

SAILS FOR FISHING BOAT--A new, energy-efficient method of fishing is the use of sailboats. Such a fishing boat has been produced in France by a ship-builder and a ship's captain. The boat has a sail area of 200 m² and is reported to sail at 10 knots in a good tail wind. It is estimated that the boat, which has been christened the Eole, will save about 6,000 kronor per week in fuel costs. The boat requires a crew of five. So that the boat will not be at the mercy of the wind, it is also equipped with a 100 kW (140 hp) motor. [Text] [Stockholm NY TEKNIK in Swedish 10 Sep 81 p 35] 9336

CSO: 3102/38

END

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29 December 1981

West Europe Report

SCIENCE AND TECHNOLOGY

No. 85



FOREIGN BROADCAST INFORMATION SERVICE

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WEST EUROPE REPORT

SCIENCE AND TECHNOLOGY

No. 85

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BIOTECHNOLOGY

BRIEFS

METHANE PRODUCTION--The "Pasteur Institute," a research center for biochemistry, biotechnology, and gene engineering, which is now held on a majority basis by "Sanofi SA" (Elf-Aquitaine Concern), and "Soc. Lyonnaise des Eaux SA" over the next 3 years want to work together in the area of methane gas production with the help of microorganisms. Lyonnaise and its affiliates "Triga SA" and "Degremont SA" have for years been specializing in waste processing and water purification.
[Text] [Duesseldorf EUROPA CHEMIE in German No 28 1981 p 487] 5058

CSO:3102/70

ENERGY

SUBSIDY FOR FLUIDIZED-BED COMBUSTION DEMONSTRATION PROJECT

Amstelveen ENERGIE SPECTRUM in Dutch Nov 81 p 274

[Article: "Subsidy for Industrial Demonstration Project on Fluidised-Bed Combustion"]

[Text] A subsidy in the maximum amount of 1,230,000 guilders has been granted for a demonstration project on the atmospheric fluidized-bed combustion [AFBC] of coal in industry. It involves a project whereby, for the first time in the Netherlands, an AFBC installation is used to produce steam for the use of a commercial product. The AFBC will be installed in the sand-lime brickworks at Koningsbosch (Limburg).

The subsidy will be paid from funds which are available to carry out research development and demonstration programs involving coal. In part 2 of the Memorandum on Energy Policy (the Coal Memorandum) the government provided the impetus for such a project. Next, a program preparation committee produced a proposal for a National Coal Research Program [NOK].

A government position on this proposal will be issued shortly. The preparation committee proposal specified, among other things, that it is necessary to achieve an industrially oriented development program for the accelerated introduction of AFBC boilers. Hence, the demonstration project for which a subsidy has now been granted also fits in the above mentioned proposal.

The demonstration project in the sand-lime brickworks involves an installation with a capacity of 10 tons of steam per hour. Coal consumption amounts to approximately 5,300 tons per year. The project is considered a representative demonstration, both technically and economically, of a small AFBC boiler for the generation of low pressure steam.

The Netherlands Energy Development Company [NEOM] is closely involved in this project; the European Community has promised financial support. The performance of the boiler will be carefully recorded within the framework of a measuring and demonstration program. In this connection, the emphasis will be on the technical-economic and the environmental health aspects. At the same time, attention will be given to the removal of residue. As far as the latter is concerned, the sand-lime brickworks offer eminently good opportunities to incorporate the residue into bricks.

8463
CSO: 3102/50

ENERGY

COAL HYDROGENATION PLANT IN OPERATION

Duesseldorf EUROPA CHEMIE in German No 28, 1981, p 487

[Text] Following the construction of a demonstration plant for the high-pressure gasification of coal by the Saarbergwerke outfit and the "Dr Otto & Comp. GmbH," now a pilot plant for coal liquefaction connected with the Saarberg-BP [Benzin- und Petroleum AG/ subsidiary "Association for Coal Liquefaction, mbH" has begun hydrogenation operations. With this plant--which allows one to optimize the processes involved--experience is to be gained for constructing and designing a large plant. Objectives of the testing are, among other things, to decrease the hydrogen consumption, to reduce the process pressure to a maximum of 300 bars, to improve the thermal efficiency, and also to increase adaptability in relation to the quality of the coal used and the hydrogenation products.

Rudolf Lenhart, chairman of the Saarbergwerke managing board, made it clear that regardless of the economic efficiency of the process--relative to German conditions--this technology will continue to have need of assistance from the State. In his opinion, a stop-and-go policy is not congenial to hydrogenation technology. According to Lenhart, one cannot "mothball" an intermediate stage of this technology and get back into development without any interruption when the basic conditions are more favorable. The component of experience needed with this technology is simply too great to do this, he said.

And so the demand for government aid in the construction of a large plant is a necessary consequence of this train of thought. It is understandable that the above outfit would prefer to have the large plant located in the Saar area, in view of its financial and technical commitment, especially since it can point to both process-engineering and site-related advantages. But even a bidder from the Ruhr surely does not have fewer advantages to show for the construction of this sort of large plant in the Ruhr district. In view of the low ebb in the budget finances of the research minister, it is unlikely that anything but a large plant will be able to secure any public assistance, in which case it may be built on the North Sea coast of Lower Saxony--because of the potential for using cheap imported coal.

12114

CSO: 3102/61

ENERGY

BRIEFS

SYNTHETIC FUEL PLANT--An energy plant for the generation of synthetic motor fuel in quantities sufficient to meet about 10 percent of Sweden's gasoline requirements, is to be built in Nynaeshamn, 55 kilometers southeast of Stockholm. For this purpose, the electric concern ASEA, AB Nyneas Petroleum (member of the Axel Johnson Group), and Storstockholms Energi AB (STOSEB, supply enterprise for energy deliveries in the Great Stockholm area) will form a consortium to plan and build the plant. The production effort can be based on coal and heavy oil residues. They will be converted into heating gas and synthetic fuel (methanol or synthetic gasoline) by means of a coal gasification process and chemical synthesis. The low-grade waste heat developing during this process is recovered and supplies hot water for district heating in the Stockholm area. In this way it will be possible to reduce Swedish crude oil imports by 1 million tons per year. An even greater reduction in oil requirements can be achieved by lowering the temperature of the return water by means of heat pumps before that water is pumped back to Nynaeshamn. If the heat pumps are also used to recover heat from other low-grade waste heat sources, then it will be possible to save as much as 70 percent of the oil consumed in Stockholm today for heating purposes. The emissions of the energy plant would be extremely small, compared to those coming from conventional plants, running on coal or oil, for the generation of heating gas and hot water. The sulfur dioxide emissions can be reduced by 10,000 tons per year. The energy supply plant in Nynaeshamn is scheduled to go into operation in 1987-1988. [Text] [Bern TECHNISCHE RUNDSCHAU in German 20 Oct 81 p 11] 5058

FUNDS FOR BIOMASS ALCOHOL--The results of the research and development projects pertaining to the extraction of ethanol from biomass are so encouraging in terms of the technology involved, energy balance, and profitability that a decision may be made even in the near future concerning the construction of commercial-scale test plants. This was stressed by the parliamentary state secretary in the federal research ministry, Erwin Stahl, in answer to corresponding questions from the Bundestag. According to Stahl, the operating results of such plants will give information about the limiting economic conditions under which an ethanol extraction from biomass will be possible on a larger scale in the FRG. For its part, the federal food ministry wants to give assistance totaling DM 2.4 million for the construction and operation of a demonstration plant for the extraction of ethanol from residual substances of sugar production and from beet juice. At the same time, the federal research minister wants to support the development of new biotechnological procedures for the digestion

and fermentation of various initial products of vegetable origin, as well as the search for and genetic optimization of new, powerful strains of micro-organisms for the extraction of ethanol. Up to now, about DM 4 million of development funds have been allocated for this purpose. Moreover, the development and commercial-scale testing of general processes for ethanol extraction have received assistance within the framework of the raw-material research program. To this end, funds amounting to DM 7 million have been promised. [Text] [Duesseldorf EUROPA CHEMIE in German No 28, 1981 p 487] 12114

AID FOR COAL CONVERSION—Frankfurt, 8 November. The 1982 budget of the federal ministries of economy and of research and technology allocates a total of DM 293.3 million for coal refining activities. The Economic Ministry is to confine itself to the support of large-scale technical coal refining plants while the Research Ministry will help finance research and development up to the prototype plant. The Economic Ministry's budget includes DM 50 million for large-scale industrial coal refining plants plus DM 950 million for obligation authorizations. The use of these obligation authorizations however requires the approval of the budget committee. The following areas will be supported in 1982 for coal research through the Research Ministry according to the ideas of the research minister (in millions of DM):

Gas generation from coal	12.0
Coal liquefaction	10.0
Electric power generation from coal	15.0
Coke production and direct combustion	4.0
Deposit exploration	5.0
Digging and mining systems	7.2
Processing	0.1
Gas generation from coal	119.0
Coal liquefaction	121.0

[Text] [Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 9 Nov 81 p 7] 5058

CSO:3102/71

INDUSTRIAL TECHNOLOGY

REPORT ON USE OF CNC MACHINE TOOLS IN FRG

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 2 Nov 81
p 7

[Unattributed article: "CNC Machine Tools Lower Costs. In the FRG There Are About 25,000 Numeric Machine Tools"]

[Text] After initially slow acceptance NC [numerically controlled] machine tools in the FRG have been rapidly becoming established since the mid-1970's: it was determined that for mid-1980 there was an inventory of about 25,000 units, and in 1980 alone about 4,000 to 5,000 new installations. This information comes from the Fraunhofer Institute for Systems Technology and Innovative Research, Karlsruhe. The technical development was marked by the transition from conventional (wired) NC systems to stored-program CNC [computer numeric controlled] systems. These CNC systems, in contrast to conventional NC systems, have the following advantages: declining costs of acquisition for controls, expansion of possible uses, higher flexibility and quality improvement, and more intensive uses. In addition to these economic advantages, in the work organization the CNC systems open up opportunities for qualitative improvement of work places where program optimizing and debugging and programming itself are transferred to the operator.

The study which has now been produced concerning the "economic and social effects of the use of CNC machine tools" is based primarily on written questioning of user companies and on numerous case studies. The CNC machine tools are primarily in use in the FRG in the following branches: machine building (47 percent), vehicle building (13 percent) and the electrical industry (9 percent). They are being increasingly used in single-part production and in large series production (in 1980: 10 percent in single-part production, 50 percent in small series manufacture and 40 percent for larger series).

In the case of the kinds of use related to the work organization, programming in operations scheduling clearly dominates in contrast to machine shop programming (78 to 22 percent). Fifty percent of the skilled workers work as machine operators on CNC machine tools which have been recorded on the basis of broad surveys; in this connection the share in machine shop programming at about 80 percent is almost twice as large as in programming operations scheduling. In 1980 about 20,000 machine operators worked at the approximately 12,000 CNC machine tools in the FRG. As a result of the rapid spread, about 7,000 additional CNC machines operators are required annually.

The Institute observed that on the other hand, each year, on the basis of mathematical figuring alone, some 9,000 operators are freed from conventional machine tools. But only in part does this have an effect since the personnel savings are often compensated for by corresponding increases in capacity. Increasing the degree of automation and machine performance will result on the average in a 40-percent reduction in manufacturing time. In addition, it was possible to achieve a reduction in costs for control, reworking and rejects, but machine costs are 30 to 60 percent higher. Overall, the case studies revealed that manufacturing costs could be reduced up to 40 percent. Personnel savings on the average were 50 percent.

The economy of CNC machine tools is judged very favorably by the users, it often exceeds the values determined in figuring the investment. In this connection, the decision on various possibilities for organizing work in the enterprises is still extensively done without detailed comparisons of economical operation. The advantages and disadvantages of CNC-specific machine shop programming are of course in part a subject of controversial discussion in the enterprises, but there is no quantitative comparison of the relevant magnitudes of costs and benefit because of the lack of values based on experience. Thus, additional practical experiences and improved cost-use analyses are necessary in order to be able to define efficient ranges of use for the various kinds of machine shop programming.

12124

CSO: 3102/48

METAL-ACTIVE-GAS WELDING ECONOMICAL, EFFICIENT

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 4 Nov 81
p 5

[Article: "Mixed Gases Prevail in Metal-Active-Gas (MAG) Welding. A Serious Alternative to Rod-Electrode Welding. Actual Examples From Practice"]

[Text] In contrast to other welding processes there has been a steadily increasing trend toward using shielded-arc welding. In respect to manufacturing and repair welding, all welding processes are wage-cost intensive. In the rationalization and use, respectively, of economical welding methods there is the possibility, given the high wage-cost level, of guaranteeing the competitiveness of a manufacturing plant and of retaining jobs. In particular, mention should be made of the MAG-M welding (=metal-active-gas welding using the mixed gas corgon with a continuously fed wire electrode) as an outstanding shielded-arc welding process. According to data from Linde Ltd, this process is extensively replacing welding with rod electrodes because of its economic and universal uses.

In the application to structural steels the two processes mentioned compete with one another, and it seems certain that for production reasons in many cases the trend will be toward further use of MAG-welding; this is also statistically demonstrable. Typical of the MAG-welding method is, among other things, the fact that with each wire electrode (0.6 to 1.6 mm) a broader deposit range can be used. In comparing maximum deposit efficiencies, the efficiency with MAG is two to three times better, resulting in a correspondingly shorter welding time for welds of the same length with equivalent savings of wage costs. Thus, approximately 50 to 70 percent of the arc burning time is saved for welds of equal length.

The auxiliary process time is also an integral part of the process; this includes cleaning up spatters, cleaning nozzles, nipping wire ends, removing slag, changing electrodes. Here, too, the auxiliary process times vary according to the process. In the case of rod-electrode welding two auxiliary process periods are required for single-pass welds (because slag is removed only once) and up to four periods are needed for multipass welds. The costs of fillers are the third feature which influences costs. If the stub length is short (60 mm) only 600 grams of weld metal are used from 1,000-gram welded rod electrodes. With MAG-M-welding the effective recovery from 1,000 grams is 950 grams if corgon mixed gases are used and 900 grams if carbon dioxide (MAG C) is used.

Because of the differing effective recovery with MAG-welding it is possible to achieve filler savings, on the basis of list prices, of 30 to 40 percent per kg of burned-off weld metal. In the actual example of a disinfecter, Linde has demonstrated a savings of about 40 percent for MAG. In the disinfecter with 100 m of fillet weld there are about 40 kg of weld metal-disinfecter. In experiments done in the companies, about DM80 in filler costs were saved based on the filler cost difference of about DM2 per kg.

In addition to the possibilities for lowering welding costs the following advantages of MAG-welding should be taken into consideration: on the one hand, welding in all welding positions with the same wire electrode, and on the other hand, the capability of bridging gaps with certain fusion at the root; moreover, the possibility of totally mechanical welding with a fixed welding torch in combination with welding devices must be mentioned.

With increasing costs of electric energy, costs take on more importance. As a rule the energy costs with MAG-welding amount to 50 percent as compared to rod-electrode welding (100 percent). Depending on the useful life, the investment in a MAG-welding facility is amortized in one-half to 1 year. MAG-M-welding is therefore an economical alternative to rod-electrode welding because on the average there are 50-percent savings in total costs.

In the case of MAG-welding there is definite evidence of a stronger trend toward mixed gases although mixed gases have a higher cost for the shielding gas. This higher gas price comes from the high share of inert gas (argon) from 80 to 90 percent depending on the kind of corgon mixed gas. In spite of a cost for shielding gas that is more than twice as high (carbon dioxide: DM1.75 per cubic meter and corgon 18: DM3.80 per cubic meter), on the basis of cost studies the cost difference of DM0.32 for shielding gas could be made up for by all the savings in welding time, cleaning time and wire consumption (total costs per part with carbon dioxide: DM14.22, with corgon 18: DM11.52). These cost advantages were demonstrated in further cost analyses, among other things, for transport containers, door hinges on automobiles and gear wheels.

According to information from Messer Griesheim one mixed gas (Krysal) in connection with MAG-welding also provides the opportunity to combine the advantages of the steady argon arc with the properties of an active gas which improve penetration. Particularly in the case of manual MAG-welding it is frequently a matter of bridging gaps, of working in fixed positions. With a universal mixed gas of 82 percent argon and 18 percent carbon dioxide, the carbon dioxide increases the viscosity of the weld metal. The danger of weld defects is reduced. Argon/carbon dioxide mixtures combine the advantages of the two gases: argon gives a steady and spatter-free arc with, of course, fingershaped, mostly unsatisfactory penetration. On the other hand, carbon dioxide causes broader penetration, yet the discharge of spatters is undesirable as an economic factor.

It was ascertained that adding 18 percent carbon dioxide produces a balanced proportion between the advantages and disadvantages of both gases; even though not spatterfree, the droplet transfer is at least low in spatters. At the same time sure penetration is achieved in the process. Whether in crane building, or boilermaking or in making various kinds of equipment--there are numerous

enterprises which currently do welding jobs with this mixed gas which require licensing. Even the bridge building department of the FRG railroad has confirmed that it meets the safety requirements for structures subject to dynamic stress. With rust- and acid-resistant steels, which are subject to corrosive stress, one should, however, be careful with mixed gases. The proportion of carbon dioxide in the shielding gas should never exceed 5 percent.

The danger of carburization and the associated formation of chrome carbide, and thus chrome depletion, must not be ignored. The situation is different with austenites which are intended for coating. The austenitic wire electrode with 18 percent Cr, 8 percent Ni and 6 percent Mn can be welded in an excellent manner with this mixed gas. Resistance to chemical reactions is not a requirement, but toughness and resistance to wear are. A possible increase in the proportion of carbon in the weld metal is in this case a likely advantage. In respect to the primary areas of use it should be noted: this mixed gas is applicable in almost all situations, whether they be heavy construction parts with seams in gravity position, welding in fixed position such as railcar building. The mechanical property data are excellent in the case of welds on high strength structural steels.

According to Messer Griesheim, corgon, too, like this mixed gas, is universally usable as an individual shielding gas for MAG-welding; with 90 percent argon and 5 percent each oxygen and carbon dioxide it is also well suited for thin-walled components because of the surface-stressed heat emission. The active components, oxygen and carbon dioxide, give specific and varying characteristics to the processes in the arc and thus the material transfer. Carbon dioxide primarily influences the shape of penetration, oxygen promotes the presence of fine drops.

Mixed gases with 92 percent argon and 8 percent oxygen and 88 percent argon and 12 percent oxygen (argomix), respectively, are available as fast shielding gases for MAG-welding. Argon provides a smooth, steadily burning arc. When welding steel, however, the material transfer is in coarse drops. The shape of penetration is not satisfactory in the case of joint welding; oxygen takes care of that. It relaxes the drop surface and thus produces a fine-drop fusing of the wire electrode and with additional combustion heat it provides broader and deeper penetration. And the boiling points of oxygen and argon are very close, thus the result is a stable mixture, even when not in the liquid state. The addition of oxygen improves the transfer of heat from the arc to the component. The result is good coalescence, rapid welding feed, high performance, thus well suited for mechanized and automatic welding, primarily in large-scale series manufacturing.

12124

CSO: 3102/48

INDUSTRIAL TECHNOLOGY

SUPPORT FOR DEVELOPMENT OF ADVANCED HANDLING SYSTEMS

Duesseldorf VDI-Z in German No 19, Oct 81 p VIII

[Text] For about 2 years now, the Federal Ministry for Research and Technology has been supporting research and development projects within the framework of the Manufacturing-technology Program. The aim of this has been to strengthen competitiveness in key areas of the capital-goods industry and to increase the productivity of small-scale organizational structures in technology-intensive areas of the outfitting industry. The target group for this involves above all equippers which design and manufacture equipment and systems for industrial production, and in addition those equipment users which perform selected pilot trials and those research institutions which are working on industrial developments. This support is concentrating on projects where new ground is being broken in technology and science, substantial steps are being taken on improving equipment and procedures, and where the associated economic risks are too great to warrant private development. As a rule, the allocations to firms amount to 50 percent of the expenditures which they can assign to the project.

Examples of the sorts of problems posed in such research and development projects are (as extracted from the Manufacturing-technology Program of the Federal Government):

- Development of new, efficient industrial robots as a modular unit architectural system and for special applications,
- machine-integrated handling systems,
- further development of sensors for industrial robots,
- development of sensor-guided, modularly constructed handling devices with teachable controls,
- further development and industry-wide standardization of gripping systems,
- development of versatile ordering and storage equipment,
- working out of standardized general solutions for problems involving handling,
- further development of safety equipment for industrial robots.

Also belonging to this field of activities are software tools for the programming, operation, maintenance, and assessment of the devices. Extensive developmental results will be likely to be achieved in the future in the domain of automatic assembling. Thus programmable assembling and feeding systems represent another point of main effort in this project-assistance program.

Those who are interested in the Manufacturing-technology Program should contact the responsible project executor under the heading "handling systems": Karlsruhe Nuclear Research Center GmbH, Project Sponsorship for Manufacturing Technology (PFT), attention of H. J. Wolter, Post Office Box 36 40, 7500 Karlsruhe 1. One can also request at this address the forms for project proposals which will have an effective term from 1 January 1982 on.

12114

CSO: 3102/62

INDUSTRIAL TECHNOLOGY

COMPLETELY AUTOMATED PEUGEOT FACILITY PLANNED FOR 1983

Stockholm NY TEKNIK in Swedish 8 Oct 81 p 25

[Article by Goran Lundstrom]

[Text] The manufacture of engine blocks, cylinder heads and transmission parts will be completely automated in a plant which Peugeot and Citroen will inaugurate in France on 9 June 1983. It will be the most advanced plant of its kind in Europe. The facility is an experimental plant which will limit its production to prototype engines.

The French venture in the areas of industrial robots and advanced manufacturing technology has now got properly started after much research at the state level.

This is how the automatic machining will take place:

The pieces to be machined, which must be maximum 500 X 500 X 500 millimeters, are loaded at two stations on rail waggons, the so-called pallets. Throughout the working process, they remain fastened on these pallets.

Signalling Problem

After the drilling station, an industrial robot blows all apertures clean. The machining time per part varies between 40 and 70 minutes. The operation of the entire system will take place from a general computer. The numerically-controlled machinery, which was ordered recently, has its own controls which take over when their respective work tables have been provided with a pallet.

Among the problems which remain to be solved is the signalling of, for example, damage to tools. In the case of the larger manufacturing tools, this is normally less difficult since the breakdown of a tool will cause a major change in the power needs of the propelling engine, a change which may be used as a stoppage or warning signal. Where small tools break down, the corresponding signal will be much too weak, and other methods of detection will have to be found.

Most Advanced

The software for the system has been developed and was recently simulation run with a good result. When the plant is ready, it will be one of the most advanced plants in Europe. There are several similarities between the project of Citroen and a project which was recently started at the Royal Institute of Technology under the auspices of the Institute for Engineering Research.

INDUSTRIAL TECHNOLOGY

BRIEFS

PLASMA STEEL TECHNOLOGY--5 Nov--The Journal of Metals No 9/1981 reported that in February of this year the first construction stage of an iron-sponge production plant, which operates on the basis of a plasma technology developed by SKF [Swedish Ballbearing Works] Steel, was put into operation in the Swedish Hofors area. The iron sponge produced is an important base material for the generation of high-grade steels. The production results obtained so far suggest that the functioning of these plasma generators has exceeded all expectations. It is said that very stable operating conditions have been achieved for the Plasmared plant, and the lifetime of 200 hours calculated for the electrodes supposedly has been greatly exceeded in certain cases, with up to more than 400 hours having been achieved. Moreover, the test running has shown that the energy consumption can be held within the calculated limits. For the production of a ton of iron sponge with a metal content of 90 percent, an average of 8.8 gigajoules of electrical energy were consumed. [Text] [Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 6 Nov 81 p 7] 12114

FRENCH CARBON FIBER INDUSTRY--In France, great efforts are at present being made to increase the research and manufacturing resources in respect of materials based on carbon fiber. A special body was recently set up to coordinate the activities of the different ministries with regard to composite material. The first task will be to map out the development phases within the different enterprises in order, subsequently, with financial support to facilitate the coordination of these efforts in respect of the preferred composite material. Among enterprises active within the area may be mentioned SNIAS, Dassault, SEP and Elf-Aquitaine. Several of these enterprises are located in the south-western part of France where a kind of French California for composite material is being built. Elf-Aquitaine announced recently that it will start its production of carbon fiber. In order to gain access to fully developed technology, a contract was concluded with SEP, which has already delivered composite material for aircraft and space applications. The cooperation will comprise joint research, manufacture, and marketing of all types of carbon fiber, composites and their components (carbon fiber and resins). Efforts will be made to find new areas of application, for example within the oil industry and the automobile industry. Both SEP and Elf Aquitaine have previously concluded contracts with foreign enterprises specializing in carbon fiber, resins and various types of composite material. SEP is, moreover, in negotiations with an American enterprise in order to start production of ceramic composite material where a venture is planned with state support. [Text] [Helsingborg PLASTFORUM SCANDINAVIA in Swedish No 10, 1981 p 16] 7262

SCIENCE POLICY

NETHERLANDS BUDGETS MORE FUNDS FOR S & T IN 1982

Amstelveen ENERGIE SPECTRUM in Dutch Nov 81 pp 274-275

[Article: "Science Budget for 1982 Includes More Funds for Science and Technology"]

[Text] During the eighties it will be necessary to work in various ways on the further mobilization of science and technology to the benefit of society. In this regard, a number of aspects are significant: financing, infrastructure, the conditions under which the research is to take place, and -- in relation to both of the previous points -- the social impact of the research.

It appears from the 1982 science budget that the total research effort in the Netherlands in 1982 will involve an expenditure level of approximately 7 billion guilders. Of this, the government itself will assume 3.5 billion guilders, a little less than half. Nearly 1.5 billion guilders of this will be spent by universities and colleges. Expenditures for research and development in industry are estimated at approximately 3.6 billion guilders.

Following an original decline in the years prior to 1978, the share of research in the GNP in the Netherlands has remained about the same since that year (1.9 percent). This applies both to the research financed by industry and the funds made available by the government. In terms of volume development it is also possible to talk of a stabilization since 1978.

In fact, it is even possible to talk of a certain volume increase for 1982: nearly 41 million extra guilders will be made available for space travel; expenditures for the so-called large and small development credits will go up by 40 million guilders; and the funds for energy research in greenhouse horticulture will go up by 7 million guilders. Compensation for these amounts was found elsewhere in the national budget.

These global statements on expenditures for research and development work could, in the opinion of the government, cover up rather divergent developments of the different cost components. For example, when industry refers to a modest increase in the volume of personnel expenditures, the material operating expenditures provide a much less favorable picture. This is caused by the strong increase in costs, among other things for equipment and energy.

As far as government financed research is concerned, it must even be noted that the level of assistance is becoming increasingly less adequate. The only possible conclusion is that a growing disproportion between personnel and material expenditures will be at the cost of research results. The government has deduced from the above that the volume of research efforts should remain at least the same, so that research can contribute to a strengthening of the economic base and further so that it can also properly be of service to society.

Infrastructure

With regard to infrastructure, the minister of education and science wrote that the government must guarantee a sufficiently large and highly qualified corps of researchers. There may be problems here in the near future. It has been noted that the turnover among the permanent researchers is too small. The government will shortly determine its position on the report on the problem of mobility published earlier this year by the Starting Group on Strategic Evaluation TNO [Netherlands Central Organization for Applied Natural Scientific Research].

The social impact of research will be promoted by a number of policy instruments, such as sector councils, programming bodies, transfer of knowledge, research programs oriented toward innovation, and also by means of improved financial policy machinery.

Direction of Research

During the next few years, the increased use of science and technology will have to be directed primarily toward four main areas: economic-technological development, material resources, man and environment, and society. In addition, a strong policy for basic research will be necessary in order to provide a sound basis for the application of science and the introduction of new technologies.

Economic Structure

The structure of the Dutch economy is currently experiencing a necessary adjustment, whereby the strategic policy puts greater emphasis on an information intensive production package with high quality end products. This means a strengthening and stimulation of the following areas:

- micro-electronics and related fields;
- manufacturing and design techniques, such as the use of robots and computer aided design;
- information technology, hardware as well as software;
- telecommunication and remote sensing;
- maritime and offshore technology;
- biotechnology;
- industrial organization and industrial management.

The supply of raw materials and the supply of energy are also important for the changing economic policy. Energy research in the eighties will be primarily directed toward conservation and toward sources of energy different from those used today. Research in the area of raw materials and equipment is very significant for innovative developments in industry. It will be primarily directed toward replacement materials and toward the recycling and processing of (waste) materials. In

addition, it is necessary in more general terms, to promote the science of materials, also in the basic sense of the word.

As far as environmental policy is concerned, it has been noted that its close intertwining with energy research and with industrial technology is increasingly visible and only makes the problems more complex. Environmental and nature research are still too fragmented. It will be necessary to look for a long term approach in which a great deal of attention is given to the prevention of environmental pollution.

Industrial Technology

An estimated 4.5 billion guilders will be spent in the Netherlands in 1982 for industrial-technological research. The government will assume approximately one-third of this amount, and the remaining expenditures will have to be carried by industry. In 1979, the total amount was still 4 billion guilders; in 1977 it was 3.6 billion guilders.

Thus, according to the 1982 science budget, a rather clear growth of expenditures for technological research is involved; this growth is even "significant" after 1979. The number of people in industry who are active in research and development work, specifically in the metal engineering industry and in the chemical industry, has also gone up since 1978, following yearly decreases during the previous years. Industry's interest in research activities is also evidenced by an increase of expenditures for investments in buildings, land, machines and equipment.

Government expenditures for industrial-technological research are divisible into basic research, which in recent years has shown a slight tendency to decrease, and applied research. In the latter category, expenditures since 1978 have clearly increased, an increase which must be attributed to the innovative policy of the Ministries of Science and of Economic Affairs.

Energy Research

In the near future, the "new scarcities" of energy, raw materials and environmental goods will be important determining marginal conditions for the socio-economic development of the industrialized world. Hence, the energy policy will increasingly be determined less by the economic policy. Energy research will have to have an impact on this. Next year, at the initiative of the minister of science, studies will be undertaken on the effects of this new scarcity on the socio-economic development of the Netherlands in the medium term. Policy studies concerning demand will also be undertaken to determine whether a reduction of the energy intensive-ness of the economy through efficiency improvement and the introduction of new processes and products will lead to an improvement of the Dutch economic situation.

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TRANSPORTATION

TECHNICAL DETAILS ON NEW FRENCH HIGH-SPEED TRAIN

Essen ELEKTRO-ANZEIGER in German No 19, 1981 pp 8, 10

[Unattributed article: "Jets Getting Competition"]

[Text] At least on the Paris—Lyon run, a rail connection has since 22 September 1981 been so fast that one can speak of competition for modern jets which must be taken seriously.

With enormous investments--there is talk of more than DM 4 billion for research, development, and construction--the French State Railroads have established a rail transportation system (TGV [Very High-Speed Train]) which for the time being has no equal in Europe. With speeds of up to 260 km/hr (the record, established in the spring of 1981, is 380 km/hr), the travel time from Paris to Geneva is reduced from 5 1/2 hours to 3 hours and 19 minutes. Even the well-known Japanese express trains on the Shinkansen line are still rather slow with a speed of 210 km/hr compared to the TGV (Tres Grande Vitesse or very high speed, in English).

The French State Railroads do not only want to win motorists and air travelers over to rail travel but with the TGV they expect to consume about 100,000 t of oil per year less in France. The TGV network is to be expanded to Marseille and Montpellier and, via branch lines, it is to service the most important cities in the southeastern part of France as well as Geneva and Lausanne in Switzerland.

Less Energy

The per-passenger energy requirement in the TGV, compared to the automobile, is one-half and compared to the passenger aircraft one-fifth, it says in a cost study prepared by representatives of the French Transportation Ministry, the Transportation Research Institute, the SNCF [French State Railroads], and industry together for the French Rapid Transportation Club. During its first year of operations, this new train connection will yield a time saving totalling 18 million hours for travelers who already take the train on this route. Moreover, the trains can run also during bad or winter weather, something which is not always possible in the case of the automobile or the airplane.

The French State Railroads expect an annual 17 million passengers during the initial phase; by 1985, the figure is to be 22 million.

And all of them will travel comfortably and safely. The cars are tastefully appointed; they are air conditioned and they have comfortable cushion seats in the first and second classes. Meals are served at the seat. "The train noise in the interior of the car, at full speed, does not even attain the sound intensity of normal conversation," said a SNCF spokesman. With its quiet running, the TGV is superior to most conventional trains.

Less Weight

Comfort, speed, reliable operation, and economical energy consumption in the TGV are connected with technical innovations which are the result of more than 25 years of French express train research. It is especially the light-weight construction and the excellent rail placement of the TGV which, in express travel, contribute to lower energy and line maintenance costs.

The maximum axle loads are only 17 t, as against 21 t in the hitherto fastest SNCF motor coaches. And because the TGV while in operation is more than 20 cm lower above the tracks than a conventional train, the air resistance is also reduced.

The lesser weight and the lower profile were achieved by means of several technical refinements. That includes the train's articulated design, a novel truck design with improved power transmission system, and the use of Du Pont polyimide foil called "Kapton" as insulating material in the drive motors.

The TGV consists of eight passenger cars and one, each, engine at the head and the end of the train. Each engine rests on two motorized trucks and provides a third motorized truck under the connecting car with energy. The ends of two neighboring passenger cars, each, which face each other, are on one and the same truck.

With the help of this principle, the ten-part TGV train does not have the usual 20 trucks but only 13. This means that the weight of seven trucks can be eliminated. The design in the form of the articulated power train with common trucks for neighboring passenger cars is also the key to the energy-saving aerodynamic properties of the TGV. Here, the vehicle bottom is only 1.02 m above the rails, contrary to the hitherto lowest French individual car with 1.25 m. Additional important aerodynamic features of the TGV are the streamlined shape of the forward and rear train parts, the directly meeting passenger cars, the particular curvature of the side walls and the reduction of any protrusions on the roof, under the car body, and on the sides.

The common trucks also increase the riding comfort. Because they are at the ends of the cars, no part of the passenger compartments is directly over the wheels.

The new powered truck type used in the TGV weighs 2 t less than a conventional motorized truck. This is achieved by not attaching the traction motors to the trucks but by suspending them under the car bottom. Power transmission to the drive axles is accomplished via a rubber-joint drive shaft which absorbs all vertical, transversal, rotating, or oscillating movements of the vehicle that are caused by the trucks.

The engine insulation equipment, developed by Alsthom-Atlantique, the leading company in the group of enterprises participating in the development and production of the TGV, also helps save weight. On the basis of experience with this material in its other high-performance traction engines, the company selected "Kapton" polyimide foil by Du Pont for the insulation of the armature and stator coils.

Bernard Jouy, chief engineer for rotation machines in the company's drive motor study group, explained: "The excellent dielectric properties of 'Kapton' at high temperatures makes it possible to keep the insulations much thinner and to arrange the conductors closely next to each other to a much greater extent than when we use other insulating materials in class H.

"Compared to conventionally insulated engines of the same capacity, we were able to reduce the armature coil length by 7 percent and the engine weight by 5 percent in our new TAB-676 motor for the TGV. Experience tells us that 'Kapton'--in spite of its higher price when compared to conventional insulating materials--facilitates a reduction in the general production costs by 3 percent."

It was furthermore found that the reeling technique provides additional protection against so-called pin-hole formation and makes for a more uniform thickness of the insulating layer especially along the edges and corners of conductors with rectangular cross-section.

In the TGV engines, the individual conductors are insulated with "Kapton" F, a polyimide foil which, for hot-sealing is coated with "Teflon" FEP fluoride plastic, likewise by Du Pont. Thereafter, the conductor bundles are wound with mica glass-fiber tape and uncoated "Kapton" H. The aramide paper "Nomex"--likewise developed by Du Pont--is used as intermediate layer. In conclusion, the finished armature coil is vacuum-impregnated with solvent-free silicon, in accordance with the requirements for drive motors in the H insulation class. The permissible coil temperature is 200° C for the armature and 220° C for the stator--something which is rather unusual for drive motors.

The TGV motors are designed for particularly severe stress. On a rail line segment, for example, the TGV must negotiate a slope of 35%, where by the engines work at 1,000 a for 7 minutes.

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TRANSPORTATION

GASOLINE/METHANOL ENGINE TO BE TESTED FOR PRODUCTION

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 4 Nov 81
p 5

/Text/ The Dutch Ministry of Economics is supporting the development of automobile engines which can be operated both on gasoline and on alcohol or on a gasoline-alcohol mixture. The Institute for Applied Scientific Research (TNO) in Delft was given 850,000 Dutch guilders for this purpose.

The Institute has built one engine of this type which is quite small and can be installed in almost all automobiles. According to information from the TNO, for the present 30 cars will be equipped with it for test purposes, including 15 Volvo 340 cars manufactured in the Netherlands. The TNO wants to gain experience with the engine over a period of 2 years. Following that it should be able to be mass-produced and sold at an acceptable price. In the opinion of J. van der Weide, under whose direction the engine was developed, the system does not, of course, offer a solution to the petroleum problem. However, it is eminently suitable for a transition period. Van der Weide said that a car which can drive on alcohol alone is much more economical and performs better than any other. Of course, then it will have to be equipped with a special engine; automobile manufacturers are currently occupied with the production of such an engine.

Any kind of alcohol and gasoline mixture can be poured into the tanks of the vehicles equipped with the TNO engine. The equipment senses the amount of alcohol in the fuel mixture and adjusts it in each case to the carburetor. However, the system is not suitable for diesel engines. According to TNO data the alcohol-gasoline mixture has the same performance capability as gasoline alone. However, fuel consumption is higher, in fact 1.8 to 1.9 liters of alcohol are required in order to achieve the same performance as 1 liter of gasoline. Since alcohol is much more economical than gasoline, this should not have any great influence on overall fuel costs.

Between the two kinds of alcohol, methanol and ethanol, TNO has decided in favor of the former. Of course, ethanol would be much more efficient and better for the engine, however, its production costs are nearly three times as high as those for methanol. TNO is convinced that the Netherlands have sufficient primary materials in order for the country's entire fleet of cars to use methanol. This fuel can be produced from natural gas, hard coal or brown coal. Of the 30 million tons of hard coal which the Dutch government wants to use in 2000, 5 million tons would be required in order to let all the automobiles in the Netherlands use pure alcohol for 1 year. If 10 percent methanol is added to the gasoline, then only one to one and one-half million tons of hard coal would be needed. If natural gas is used to produce methanol, then 10 percent of the annual natural gas production would have to be used to operate all automobile engines on pure alcohol, and one-half percent of the natural gas if the fuel mixture in the automobiles consists of 90 percent gasoline and 10 percent alcohol.

TRANSPORTATION

STATUS OF 'TRANSRAPID' MAGNETIC LEVITATION PROJECT

Duesseldorf VDI NACHRICHTEN in German 16 Oct 81 p 8

[Article by Walter M. Lehmann: "'Transrapid' Rides into the Next Century"]

[Text] Magnetic rail line can close supply gap between airplane and railroad. For months now, the concrete bed of the "Transrapid" experimental facility is inching day after day into the flat land, financed by the federal minister of research and technology, between Lingen and Papenburg on the Ems. If the financing keeps step with the construction work so far, the "Transrapid 06" test vehicle will make its first round trip there early in 1983 and thus document Germany's biggest advance in the field of magnetic suspension engineering. Technically, there are hardly any problems now; but financing is causing increasing headaches for the "Transrapid" magnetic rail company consortium and the promoters in Bonn.

At the end of September, a report was delivered to a briefing session on the status of work on the "Transrapid" experimental facility between Lathen and Doerpen in Emsland. The TVE (Transrapid Experimental Facility Emsland) will, after its completion, provide a major intermediate result in the development line which was initiated already in 1969 with the presentation of the first basic model featuring a magnetic suspension and control system and a linear motor. In 1977, the BMFT (Federal Ministry of Research and Technology) decided to promote the development of track-bond rapid transit in a concentrated fashion according to the EMS (electromagnetic suspension) principle. Just 2 years later, at the IVA (International Transportation Exhibit) in Hamburg, a magnetic suspension vehicle was presented to the public with which it was possible to demonstrate the functional effectiveness of the magnetic rail line as a means of transportation for the future.

The organizational prerequisites for the TVE were created, with MBB [Messerschmitt-Boelkow-Blohm] as project manager, through the formation of the Transrapid Magnetic Railroad Consortium, which consists of the following enterprises: AEG (General Electric Company)-Telefunken, BBC [Brown Boveri & Cie.], Dyckerhoff & Widmann, Krauss-Maffei, MBB, Siemens, and Thyssen Industry AG [Incorporated], Henschel, concentrating the technical knowledge gathered by West German industry in the field of magnetic railroad development.

As explained by project director engineer Erich Eitlhuber, the first phase will bring the construction of 20.6 km of single-track bed which is to be extended to 31.5 km. The line layout will in an ideal form correspond to the requirements for a high-speed experimental plant for track-guided vehicles. The flexibility in the line layout and a maximum bank [superelevation] of 12° in spite of small radii in the turn-around loops, facilitate driving at comparatively fast speeds. Two flexible switches of differing design--which can be driven over in the straight section at a maximum speed of 400 km/hr, in the turn-off branch at 200 km/hr or 90 km/hr--are included in the tests.

The experimental line, of whose first phase so far 4.5 km of track have been finished, runs on 5-6 m high supports made of steel concrete while the longitudinal girders are made either of prestressed concrete or steel. The supports have been erected for another 1.5 km. The supports and the longitudinal girders consisting of steel concrete and prestressed concrete are made in a field factory which is in the immediate vicinity of the experimental facility and which is equipped with efficient construction engineering production installations and cranes for loads which weigh 80-160 t. The line is being built at a daily rate of 75 m. So far, 50 km of cable have been laid for the energy supply of the longitudinal stator-linear motor drive.

The framework has also been built at an experimental center. This building will be connected with the experimental line via a switch whose connection segment ends directly in a maintenance shop. There the substation for the energy supply, the control stand with systems for operations control and safety surveillance, installations for the recording and storage of measurement data, as well as rooms for experimental and operating personnel and for visitors, will be located.

The following solutions were originally considered for contactless and no-wear movement: the air cushion principle, the permanent-magnet principle, the electrodynamic (EDS) and the electromagnetic suspension principle (EMS). For technical and economic reasons, only the EDS and the EMS were further pursued in the FRG. This work was promoted by the BMFT--in addition to the great work done by the German enterprises themselves--between 1970 and 1980 with about DM 450 million. The continuation of work on the TVE is not affected by the general fund cutbacks. This involves both the completion of the experimental line and the vehicle.

The "Transrapid 06" experimental vehicle, which consists of two sections and which is now under construction, is designed for a maximum of 196 passengers. Its speed in sustained operation will be 300 km/hr and the top speed will be 400 km/hr.

We cannot expect the implementation of EMS technology beyond the TVE any time soon. The efforts toward European integration among other things presupposed a European transportation system which is characterized by particularly fast speed. Here, the EMS may fill a gap between the aircraft and the railroad which, in addition to the previously mentioned advantages, would also bring independence of petroleum. In this connection it is last but not least nuclear energy for power supply which assumes special significance. Transrapid may be something for an integrated European high-speed transportation network and at the same time it may be a challenge to European policy. To facilitate promising steps in that direction, it would be necessary to present the system developed in the FRG on a scale of 1:1

in practical operation. Lower Saxon lady minister Birgit Breuel pointed to the need for getting the public to understand the development and operation of such a system. In this connection it compared the exemplary French efforts in this field to the difficulties which were created among the public as a result of the planning of a new federal railroad section between Frankfurt and Wuerzburg.

According to the ideas of the TVE consortium, the lessons learned during the initial phase are to be incorporated for the construction of a practical operational line. The thinking here runs toward "connection lines" between several population centers and an airport. It will depend on the results of the work during the coming years and, last but not least, on further promotion whether the leading role of West German industry in this field can be preserved in the future.

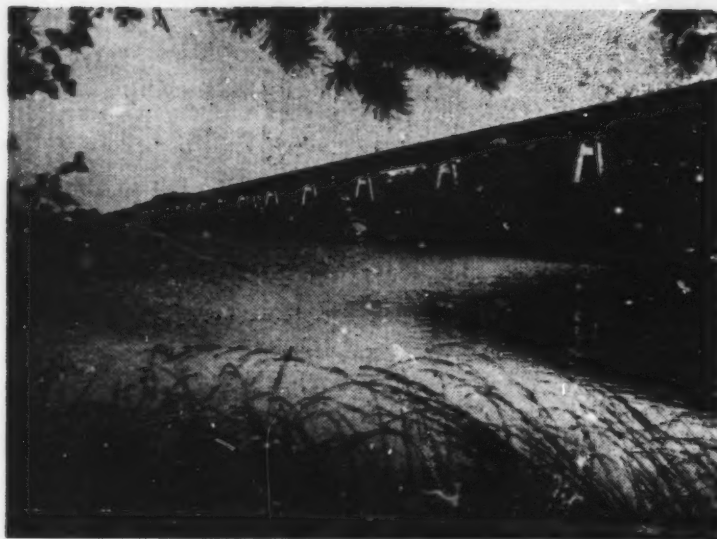
Austrian Railroads "Wired" for 3,000 Kilometers

With the conversion of the 46 km line from Tulln to St. Poelten in Lower Austria, the electrically operated sections of the Austrian Federal Railroads have reached a total length of exactly 3,000 km. In 1945, the network only consisted of about 1,000 km; since then, double that distance has been added.

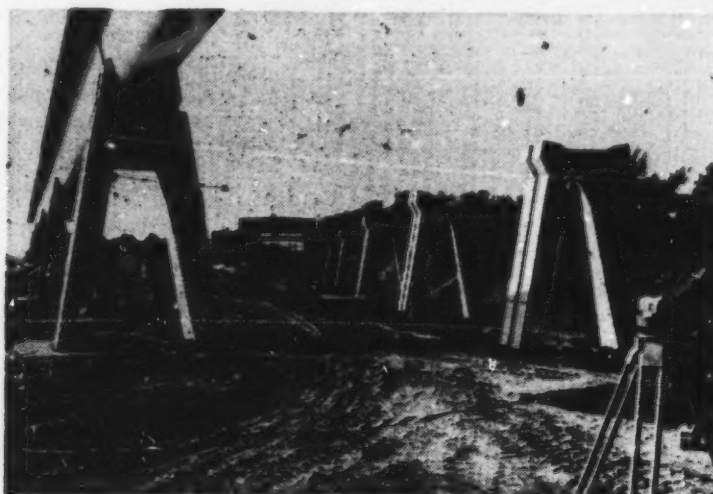
With a share of 51.3 percent of electric lines out of the total network, the Austrian Federal Railroads have reached fourth place among European rail lines and with the approximately 91 percent transportation output resulting from electric power use they even gained second place after Switzerland.

Electrical energy for train tractions comes from the seven railroad-owned power plants, two transformer plants, and five power plants not owned by the railroads with rail line power machines; more than 2,200 km of long-distance lines are used to provide energy to 41 substations where the current is fed into the overhead lines. Last year, about 1,485 Gwh of railroad current were generated with the total installed capacity of 428 Mw. About 90 percent of that come from water power. The in-house supply share of the federal railroads in Austria goes up to 50 percent and is to be retained also in case of further extension of the electrified network.

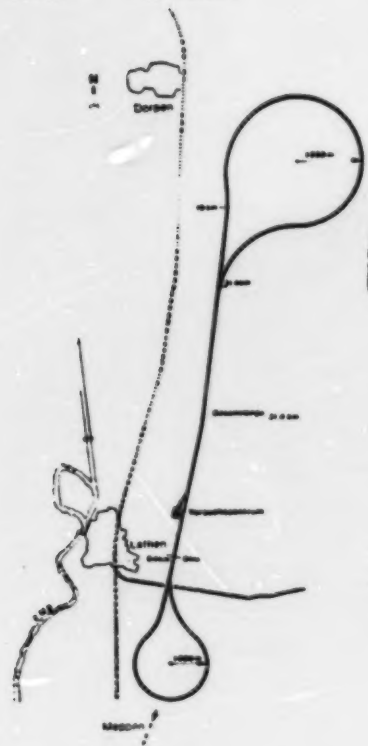
The Fulpmes Power Plant is currently under construction as a replacement for the old Ruez Power Plant; the Annabruecke Power Plant and the Melk Power Plant, with a railroad power machine, on the Danube are also under construction. (rrr)



The magnetic suspension experimental facility runs for a long distance along the Ems branch canal which was begun during the thirties but which was never finished. The line, resting on supports, with a height of 5 m between the supports, is hardly any obstacle to any other transportation routes and agriculture.



From the bed on supports (left) to the experimental center (background) runs a slow-drive siding behind which the bed goes down to level ground (right).



The dimensions of the entire system can be clearly recognized from the line layout of the experimental center at Lathen.

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TRANSPORTATION

MATERIALS RESEARCH IN CERAMICS FOR FUTURE GAS TURBINES

Vienna WIENER ZEITUNG in German 12 Nov 81 p 3

/Article by Eugen Hintsches: "Ceramics, as Hard as Iron"/

/Text/ Hairline cracks make brittle ceramic materials tougher and thus more resistant to sudden stresses, for example an impact or heat. This unusual principle was developed by Dr Nils Claussen, engineer, in the powder-metallurgical laboratory of the Max-Planck Institute for Metal Research in Stuttgart (FRG) under the direction of Professor Guenter Petzow. In respect to this unusual result Prof Petzow says: "Thus, we have achieved values for ceramic materials which equal those of today's customary hard metals."

Thus, a goal of materials researchers has come a giant step closer. In numerous laboratories people are at work on developing a gas turbine using ceramic material. This material is not only lighter, more resistant to wear and, because of its common occurrence, substantially cheaper than metals, it also withstands substantially greater heat; a ceramic gas turbine would thus function substantially more economically at higher temperatures and in addition would be better for the environment than traditional drive units made of highly refined metallic substances.

Prof Petzow confirms that "in many areas of use, primarily with temperatures about 1,200°C, it is practically impossible to use metals, ceramics are the only material alternative." Yet to date in spite of that, this material was not able to take hold. According to Dr Claussen this is "due to the genetic defect common to all ceramic materials--brittleness." In a manner different from metals, which under comparable stresses react in a plastic manner, ceramic materials break after only slight deformation, so abruptly that experts speak of a "catastrophic fracture."

However, this system of extremely finely branched microcracks functions as an obstacle that is difficult for a large crack that traverses the ceramic to overcome: as in a maze, the energy of the developing fracture is dissipated in the many hairline cracks, its forces are fanned out in a broad area and thus absorbed so that the tiny cracks open up or widen only slightly: the fracture stops. Large cracks are thus stopped by many small subcritical cracks. Not until this process zone ceases to be able to absorb any more energy does the crack develop further.

The scientists in the powder-metallurgical laboratory of the Max-Planck Institute for Metal Research realized this unusual concept by using a ceramic material consisting of aluminum oxide (Al_2O_3) in which they embed tiny particles of zirconium dioxide (ZrO_2). After mixing, these two powders are hot pressed in graphite molds at 1,500°, a process common in sintering.

While cooling the embedded particles work like tiny explosive charges. The crystal lattice of the zirconium dioxide changes at about 1,000° from tetragonal to monocline shape and in so doing expands so strongly that--and this is where the brittleness of ceramics is helpful--the surrounding aluminum oxide can no longer "cope" with the resulting stresses: the desired microcracks develop.

According to studies to date the most efficient crack-collecting system exists when about 15 percent zirconium dioxide is added. The toughness of the material is increased approximately threefold by doing this. A greater amount of zirconium dioxide on the other hand again destroys the effect. The embedded particles are then too close to one another, the subcritical cracks join together into large critical cracks and thus lose their function as an energy absorber. Thus, the toughness and strength of the material are again diminished.

These "bad properties" are now being consciously utilized by the materials researchers at the Max-Planck Institute in order to "correct the inherent shortcomings of ceramics." Precision studies of catastrophic fractures have shown that cracks in ceramic material only very infrequently run in a totally even manner. Rather, the fracture often changes direction because of the nonhomogeneous nature of the material, sometimes it branches at that point. "In other words: the crack loses its energy here, the fracture is thus stopped."

This suggested to the scientists in the powder-metallurgical laboratory the idea of making the work even harder for the fracture in order to take away from it the energy which it uses to continue its course in the material.

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TRANSPORTATION

BRIEFS

COMPOSITE MATERIAL SPOILERS--In its Einswarden factory the VFW /United Aeronautical Works/ has started series production of spoilers made of carbon-fiber compound material (CFK) for the wing of the A-310 Airbus. According to orders on hand for the A 310, production comes to over 900 spoilers. The Einswarden factory is producing six spoilers per wing assembly. Aerospatiale in France is building four additional spoilers for the wing assembly. As VFW indicates in this connection, production of components of CFK has been undertaken on this scope for the first time in the German aviation industry. The CFK spoiler manufactured in the Einswarden factory has a surface area of about 1 square meter. It has a spherical shape, thus its body matches the aerodynamic shape of the back of the wing where it is to be installed. A CFK spoiler consists of resin-impregnated, reinforced-plastic honeycombs which are surrounded on all sides by multilayered carbon-fiber reinforced plastic. /Text/ /Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 5 Nov 81 p 7/ 12,124

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END